R E P O R T R E S U M E S

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TEACHER-PRODUCED INSTRUCTIONAL FILMS IN CHEMISTRY, 8MM AND SUPER 8.

BY- O'CONNOR, ROD SLABAUGH, WENDELL
ADVISORY COUNCIL ON COLL. CHEMISTRY

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TECHNIQUES FOR PRODUCING 8MM INSTRUCTIONAL FILMS IN CHEMISTRY ARE PRESENTED. IN PART I A PHILOSOPHY OF TEACHER-PRODUCED FILMS IS DEVELOPED, EMPHASIZING THE VALUE OF THE LOCAL SETTING, AND CUSTOM-MADE CONTENTS. APPLICATIONS SUGGESTED ARE (1) TECHNIQUE INSTRUCTION, (2) FILMED EXPERIMENTS, (3) INSTRUMENT FAMILIARIZATION, (4) LECTURE AIDS, AND (5) AUTO-TUTORIAL AIDS. THE SECTION ON TECHNIQUES INCLUDES DISCUSSION OF (1) CONTENT PLANNING, (2) CONSULTANTS, (3) BASIC EQUIPMENT, (4) COHERENT FILMED INSTRUCTION, (5) FILMING SPEEDS, (6) SET AND LIGHTING, (7) TITLING, (8) ANIMATION, (9) SPECIAL EFFECTS, (10) PROCESSING AND EDITING, (11) SOUND, AND (12) PLAYBACK AND USES. APPENDED ARE (1) COMMERCIAL SOURCES OF 8MM AND SUPER 8MM FILMS IN CHEMISTRY, (2) SOURCES OF EQUIPMENT, (3) COMMERICALLY AVAILABLE 8MM FILMS BY CATEGORY, (4) CHECKLIST FOR MAKING FILMS, AND (5) PROCESSING LABORATORIES. (DH)

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(8mm and super 8)

A Report Authorized by
The TEACHING AIDS COMMITTEE
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by

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and

Wendell Slabaugh (Oregon State University)

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Department of Chemistry, Stanford University, Stanford, California 94305

The Advisory Council on College Chemistry is an independent group of chemists interested in achieving improvement and innovation in undergraduate chemistry curricula and instruction at the national level. The Council collects and disseminates information through the activities of standing committees on Freshman Chemistry, Curricula and Advanced Courses, Teaching Aids, Teacher Development, Science for Non-Science Majors, Two-Year Colleges and Resource Papers. Additional *ad hoc* groups act as necessary. The Council hopes to provide leadership and stimulus for imaginative projects on the part of individual chemists.

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PREFACE

Instructional films in chemistry are really nothing new. Their value in presenting ideas and techniques has been recognized for many years, yet they are not widely used at the college and university level. Frequently films are difficult to obtain for desired schedules, too expensive to be permanent items in most departments, and *not really tailor-made for use in a specific local teaching situation.*

The authors have been exploring, for some time, the feasibility of making instructional films in 8mm or super 8 on the basis of being professional chemists, but amateur cameramen. The philosophy of this approach is that this medium may afford another teaching technique which permits the instructor to develop and construct the material according to his own needs and interests. The 8mm film makes it possible for the individual instructor (who is a photographic amateur) to produce films that illustrate topics of his choice according to his own ideas, and thus to preserve an intimate intellectual contact with his students. The 8mm film is thus an instructional medium which falls into the category of the blackboard, the overhead projector, or the classroom demonstration.

ROD O'CONNOR
WENDELL SLABAUGH

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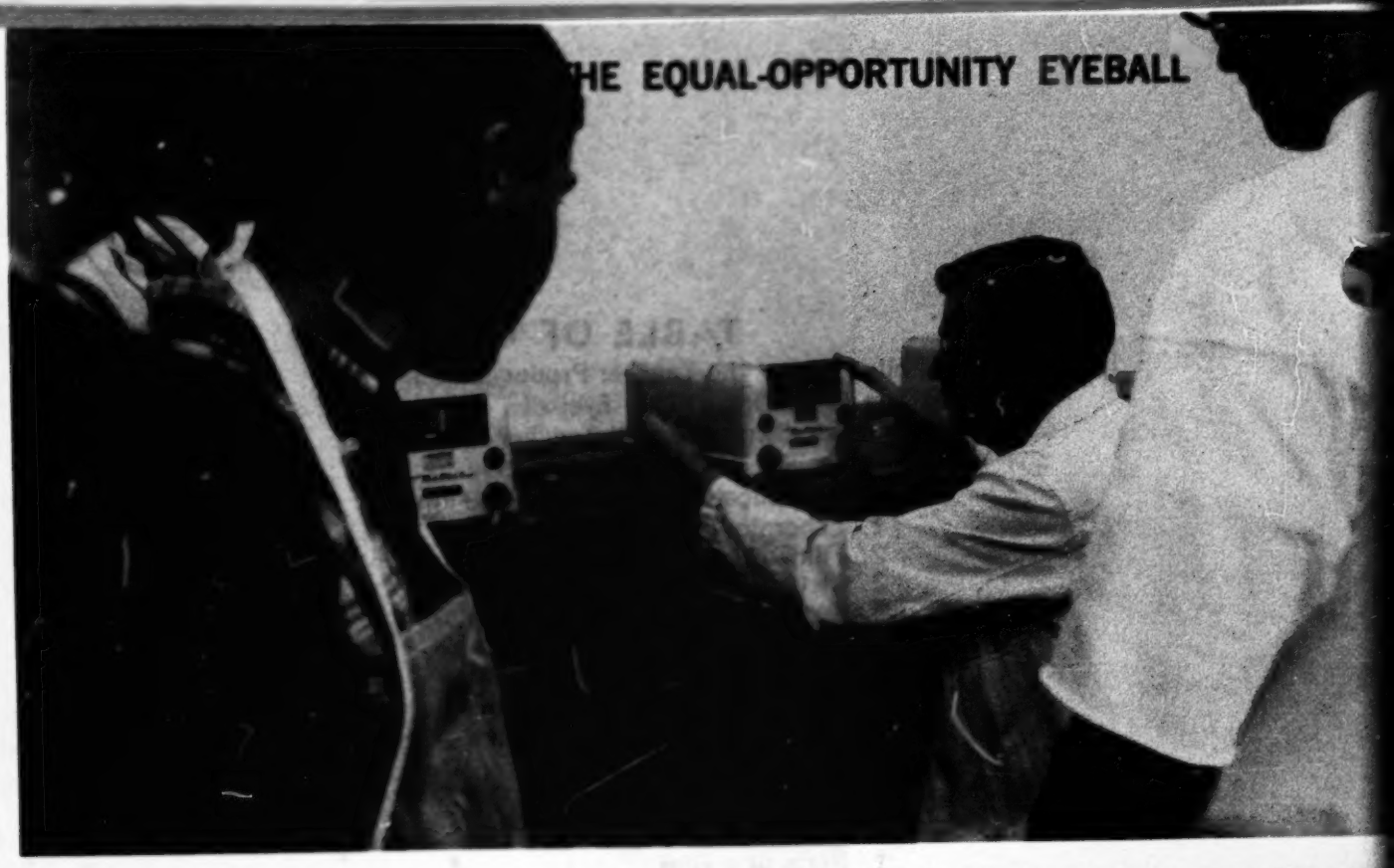
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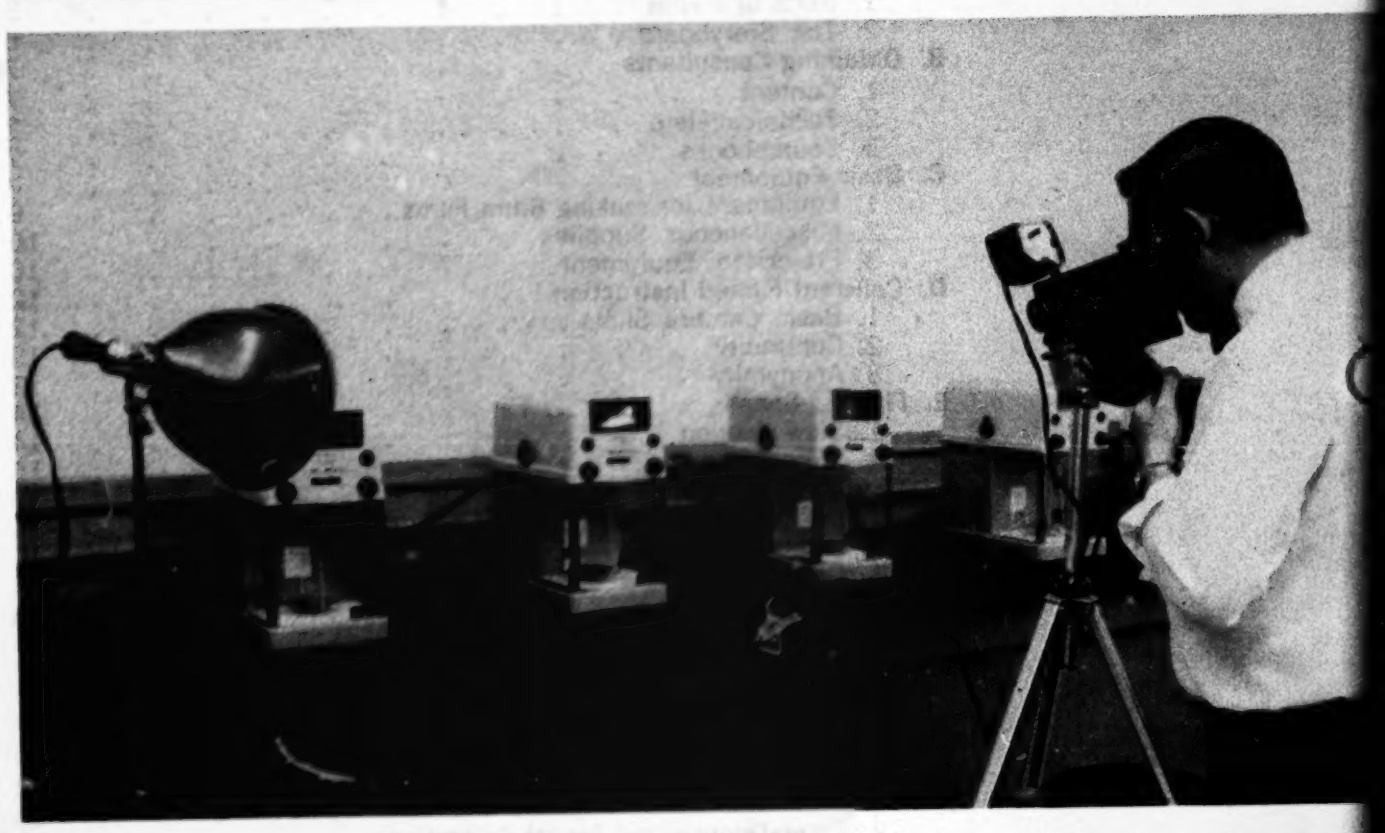

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I. THE PHILOSOPHY OF THE TEACHER-PRODUCED FILM

A. THE EQUAL-OPPORTUNITY EYEBALL

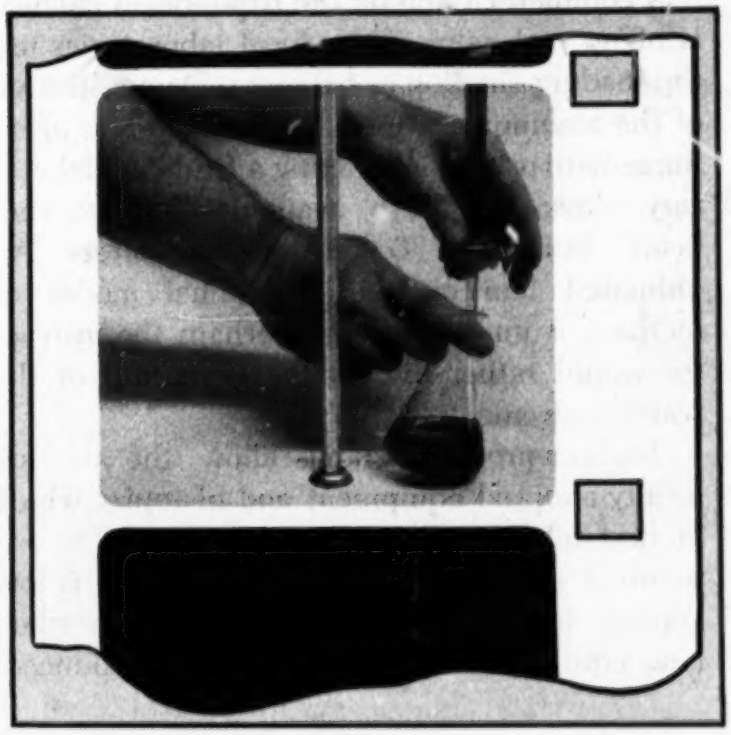
All of us have experienced the frustration of watching an interesting equipment demonstration while wishing we could *really* see what was going on. We've sat in classes where we could *guess,* but not *know,* exactly what the teacher was doing with the molecular model. Most of us have resorted to the time-consuming and somewhat boring procedure of instructing many individual students or many small groups of a larger class in the operation of the analytical balance. Wouldn't it be nice if we could provide a way for every student to see exactly what we want him to see?

Instructional film provides one of several ways in which this can be done.* It is the intent of this booklet to suggest ways in which inexpensive 8mm** films can be prepared and used to give every student an optimum view for learning. It is not intended to imply that such films are the only procedure available or, in many instances, even the best procedure. Teacher-produced films may be, however, effective teaching aids, and the techniques for their preparation and use are simple enough for almost anyone to try them.

Nothing can replace the knowledgeable teacher who understands his subject, who desires to communicate it to his students, and who uses the chalk and blackboard as his medium of instruction. But teacher-produced films provide an extremely effective way of supplementing, at the proper time, the blackboard and the chalk.

B. BE YOUR OWN "MASTER" TEACHER

For many years excellent instructional films have been commercially available. The CHEM Study series and the Fieser series on organic



"The Anonymous Hands"

laboratory techniques are examples of well-made films for lecture aids or laboratory instruction. Few of these films have received widespread use at the college level. Commercial 16mm films are often difficult to rent or borrow on desired showing dates and too expensive to include as permanent equipment in most chemistry departments. Few laboratories and individual study areas provide facilities for their use.

Perhaps even more important, most of these films have the psychological disadvantage of assuming control of the class by a "master" instructor, and chemists, by and large, are resistant to such a delegation of authority. Teacher-produced films, locally made, in which no specific person appears, allow any instructor to retain control of the teaching situation by controlling the content of the film and the narration which accompanies it. Many inexpensive 8mm silent films with only a "pair of hands" being shown are now available commercially.* Such films can frequently be used in lieu of a locally-produced film if the content is satisfactory and the teacher can still be his own "master" by supplying the narration.

*See also: **Modern Teaching Aids for College Chemistry** (AC_3 Serial Publication 18) and **Teaching Aid Programs** in AC_3 Newsletter No. 10 (AC_3 Serial Publication 28), available on request from Advisory Council on College Chemistry, Department of Chemistry, Stanford University, Stanford, California 94305.

**The term "8mm" applies here and elsewhere in this report to both regular 8mm and the newer super 8 formats.

*See Appendices A and C.

C. ADAPTABILITY TO THE LOCAL SITUATION

A commercial film on the triple-beam balance is of no real value if the local laboratories use top-loading single-pan balances. Demonstration of the technique of greasing a stopcock is of no immediate use for instructing a freshman laboratory class who have available "squeeze-the-bead" burets or Teflon-stopcock burets. An animated film on the vibrational modes of methane is interesting, but perhaps the instructor would rather discuss the vibrations of the water molecule.

Teacher-produced films allow the use of locally-adopted equipment and of topics which fit best into a given course structure. The expense of such films (in 8mm or super 8) is low enough to permit discarding old films when new equipment or new topics are introduced.

D. TESTED APPLICATIONS OF INSTRUCTIONAL FILMS

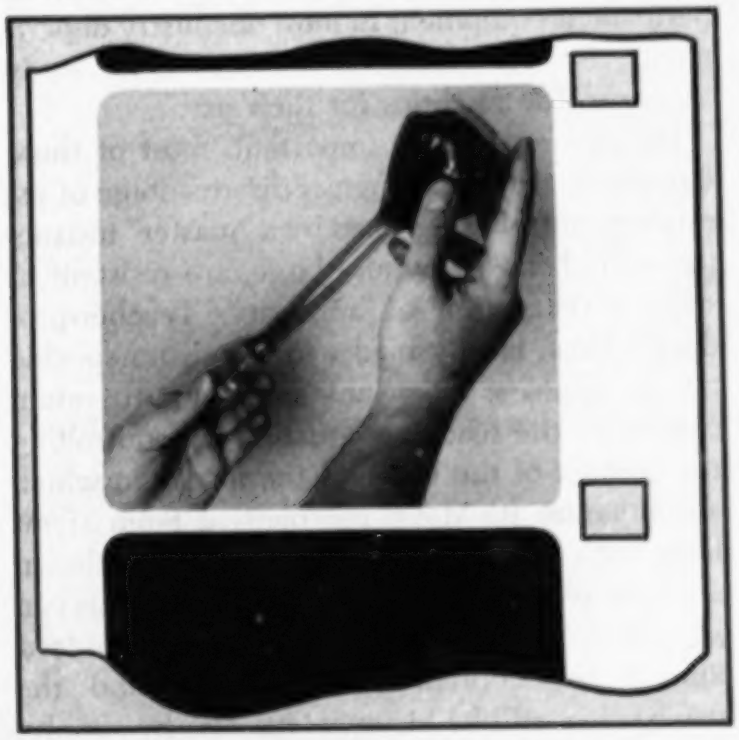
Teacher-produced films have been used in many areas with considerable success.

1. Technique Instruction:

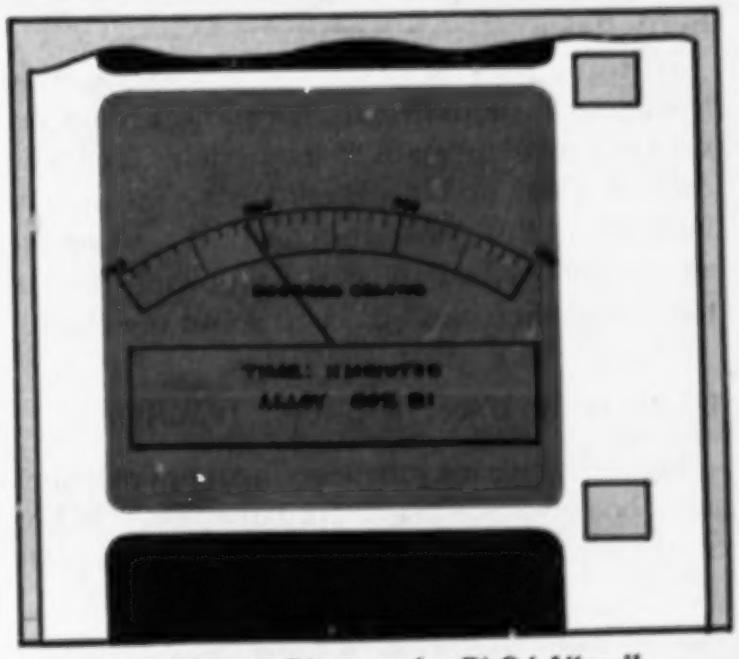
Techniques ranging from the handling of solids and liquids to the operation of an infrared spectrophotometer have been presented on simple films.* Complete pre-laboratory instructions have been given using sound super 8 films projected onto rear-projection screens in fully lighted laboratories at Kent State University; instruction in specific techniques have been presented on silent, cartridge-loaded film loops accompanied by instructor narration at Oregon State University; and, at Ohio State, filmed techniques have been shown via closed-circuit TV to many laboratory sections simultaneously. Cartridge-loaded or "auto-loading" reel-to-reel projectors have been provided in individual study carrels or undergraduate reading rooms for review of techniques or study of techniques prior to laboratory time as described in AC_3 Newsletter No. 10.

2. Filmed Laboratories:

In some cases entire laboratory investigations or problem situations have been placed on film** so that students observe the laboratory situation, obtain data, and make calculations and correlations without physically being in the laboratory. Such uses are especially appropriate where "exotic" equipment or hazardous operations are involved or where special effects such as stop-motion or time-lapse photography are important.



from "The Use of Volumetric Glassware,"
Kent State University, Kent, Ohio



from "Phase Diagram for Bi-Cd Alloy,"
LB Films, 3435 Grant Street, Corvallis, Oregon

*For examples, see Appendix C.

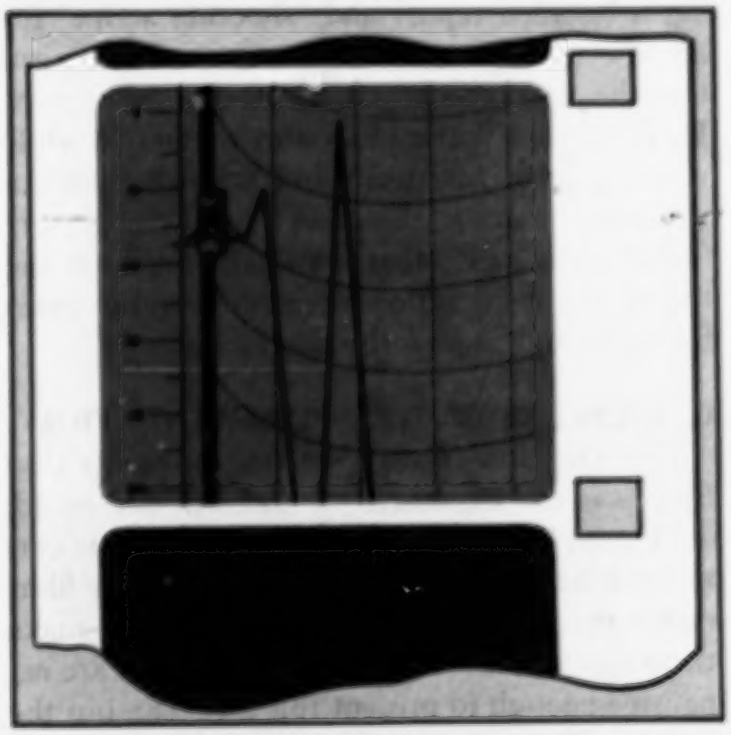
**See also: "Lab's Love's Labors Lost?" in AC_3 Newsletter No. 6 (AC_3 Serial Publication 17).

3. Instrument Familiarization

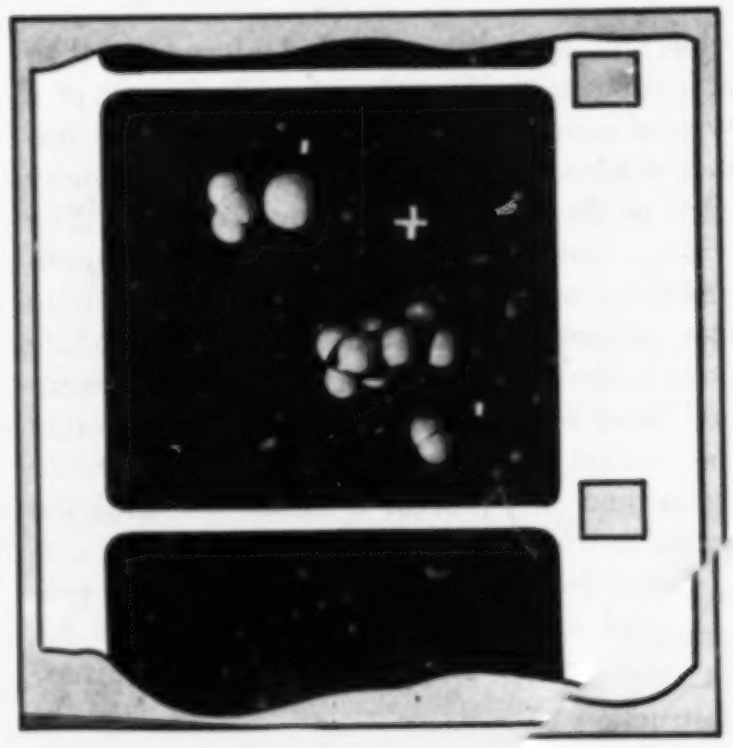
So much of modern chemistry depends on the use of instruments that the importance of a student's intimate and early acquaintance with the "gadgets" can hardly be exaggerated. Frequently, important instruments are inaccessible to lower division students, and films of their theory and operation provide valuable aids to lecture courses when discussion of instrumental data is underway. Schools not owning major equipment items may be able to obtain films from their more prosperous neighbors or, indeed, instructors from smaller schools might profitably spend a few days of summer or Christmas vacation on larger campuses making their own "instrument familiarization" movies.

4. Lecture Aids

Any good lecture-aids program should include a variety of materials so that the best can be selected for each particular purpose. Frequently, commercial 16mm films contain excellent sections on animation, complex reactions, etc. but do not warrant the time required to show the entire film in class. In such cases, it is advantageous to run the film up to the proper point prior to class and show just the brief segment desired, without sound except for the instructor's narration.



from "Infrared Spectroscopy," the Ohio State University, Columbus, Ohio, and Oregon State University, Corvallis, Oregon



from "An S_{n1} Reaction," Kent State University, Kent, Ohio

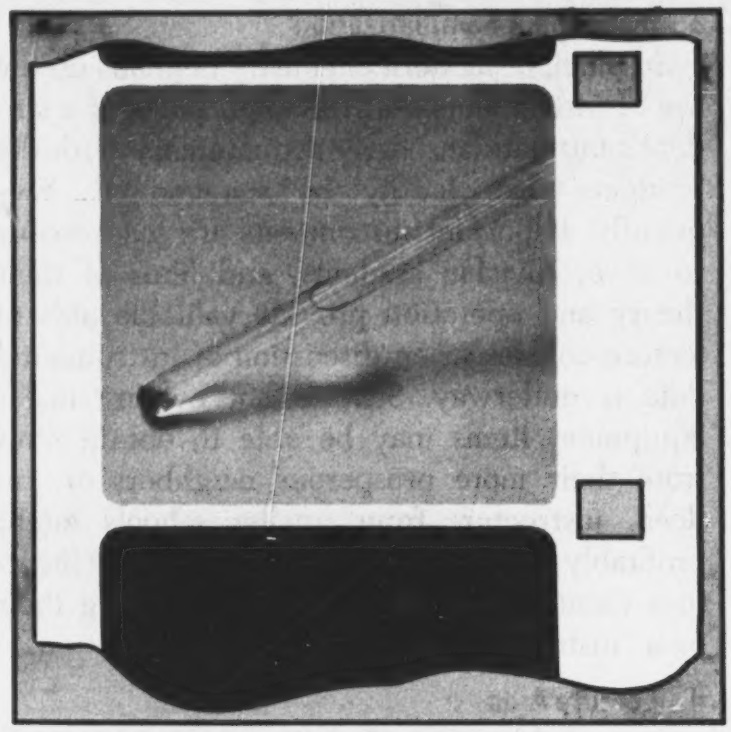
Film animation of molecular vibrations, reaction mechanisms, electrochemical processes, etc. can be prepared quite easily with 8mm cameras using conventional models. Special effects such as time-lapse photography, stop-action, or extreme closeups may also be of use in lecture film situations. The use of rear-projection screens allows such films to be shown in lighted lecture rooms, and special projectors are available for their use with conventional screens in larger auditoriums.

5. Auto-Tutorial Uses:

Individual booths (carrels) can be set up in libraries or special rooms for student study or in or near laboratories for individual review of technique films. Some designs for such areas are discussed in the *Techniques* section of this report, under the heading of "Playback and Uses."

Films may range from introduction to or review of a laboratory technique or the use of a slide rule to a problem situation for student analysis. The films may be silent, with appropriate titles or instructional booklet, or may be shown with sound on synchronized tape or on the film itself, with earphones for the student. A very useful procedure which avoids the problems of synchronizing audio tapes with films,

while still giving more detailed information than is feasible with film titles alone, is the use of a type of programmed viewing in which the student reads some instructional material and views parts of the film in alternating sequences. The written material is arranged in separate numbered sections or pages. A section is read and then film projection is begun. At the appropriate point a film title sequence states "Stop Projector and Read Section 2". At the end of that section the student is instructed to start the projector again, and this process is continued until the entire instruction is completed. Individual carrels may also be equipped with audio tapes, programmed materials, and other study aids for placing a major emphasis on "individualized" instruction.*



from "Critical Phenomena,"
Harvey Mudd College, Claremont, California

E. MULTI-SECTION AND MULTI-LEVEL USES

An instructional film prepared properly can be used in many different ways. By keeping individuals out of the picture the "master" teacher problem is avoided. Silent 8mm or super 8 movies can then be used by many instructors in multi-sectional courses, each providing his own narration live, on synchronized audio tape or on magnetic sound stripe on the film itself. The use of a number of common films in multi-sectioned courses can do much to coordinate the content of the sections.

Films prepared in the same basic way can be used at many levels by varying the accompanying narration. For example, a film on determination of an infrared spectrum could be used for physical chemistry, analytical chemistry, organic chemistry, general chemistry, physical science and, perhaps, high school chemistry. Although showing the same pictures, "level" of the presentation is determined by the accompanying narration (live, taped, or on the film), which can range from highly theoretical to elementary introduction.

F. STUDENT PARTICIPATION IN FILM MAKING

Student films have been made as individual projects, as student-teacher training programs, as substitutes for one or more laboratory exercises, or as group projects of chemistry clubs or Student Affiliate (ACS) chapters. Not only does this technique free much of the instructor's time (relegating him to the role of producer-director), but it often results in useable instructional films and in the many advantages of student involvement. A student learns more, in depth, about a reaction mechanism by preparing a detailed report and "shooting script" for his film on animation of a reaction mechanism than he will probably learn in any other way. He develops a better laboratory technique while working with his peers and following his instructor's "critical direction" for a laboratory film than in most other ways. His name on the title frame is an added incentive to make careful study and to plan the film content.

G. PROBLEMS OF THE "PERMANENT" FILM

One criticism of instructional movies is that they are too expensive to discard but could, obviously, have been better made. There is certainly a tendency to keep and re-use poor films rather than invest the time and money to make them again. Even 8mm and super 8 films are expensive enough to present this problem, but the cost is still much less than that of 16mm. The problem is further complicated if multiple prints are made.

*See also AC_3 Newsletter No. 10 (AC_3 Serial Publication 28).

If films are listed in annual budgets as "expendable" supplies a continuous program of film evaluation and replacement becomes more feasible. Quality certainly improves, at least for early work, with re-made films and a certain allowance for this improvement should be made. "Permanency" is not always bad and careful planning of initial films, especially by prior viewing of other films on the same topic, will do much to insure a film production worth keeping for some time.

H. THE ROLE OF COMMERCIAL FILMS

Commercial films in 8mm or super 8 silent form sell from $3.00 to $6.00 per minute. The teacher-produced film, *after initial equipment costs*, will run about $1.50 to $3.00 per minute just for film and processing. The cost of teacher time and other "hidden" expenses must also be considered. The cost differential then certainly justifies purchase of commercial films when the content is adequate for the instruction desired. Cost differences become larger when multiple copies of the same film are involved and usually favor locally-made films when more than three copies are needed.

Single copies of good commercial films are worth purchasing for student "reading rooms" or to provide ideas for local films more suited to specific needs.

A list of sources of film is provided in Appendix A. Some companies will provide free preview copies and all will gladly send catalogs on request.

II. TECHNIQUES

A. CONTENT PLANNING

1. Parts of a Film

An instructional film ordinarily consists of three parts – written material, scenes, and narration. The appropriate planning of each of these parts so that they fit together for a complete instructional purpose is an essential first step in film making.

Written material (graphics) consists of the film name, credits to persons involved, a copyright phrase (© Copyright (date) , (name of copyright owner)), descriptive titles to precede, follow, or accompany scenes, and written data or observations. Descriptive titles are particularly useful in silent films designed for individual viewing without any accompanying narration, although even in this case it may be unnecessary to provide many titles if reading material is assigned or discussion takes place prior to film viewing. When descriptive titles are to be used, it should be decided in advance which, if any, of these must be superimposed on actual scenes and which may be handled as separate title frames. Various techniques for adding written material are discussed in the later section on "Titling." The timing of camera shots of graphics is relatively simple. It is necessary only to measure the time required to read the material aloud and allow this much camera time.

The scenes are the essential substance of the film. No set rule applies to the length of a scene, although in general, none should be shorter than 5 seconds nor much longer than 15 seconds. As long as the action being photographed is important it should be recorded. Whenever a change in camera angle or a major change in "scene size" (closeup vs. long shots) is required, the camera should be stopped and a new "scene" begun. Use of the 4 minute cartridge films requires very careful planning of scenes, as well as of titles and possible narration. Since such films may be designed to be viewed many times by the student, it is frequently possible to put together scenes more compactly than in more conventional films. Furthermore, many cartridge-loading projectors can be stopped at any point where complex frames may be analyzed.

The time planning for scenes, on the other hand, is always a problem to the novice and can seldom be done satisfactorily "on paper," as can estimates involving written material and animation. One procedure for timing scenes of a

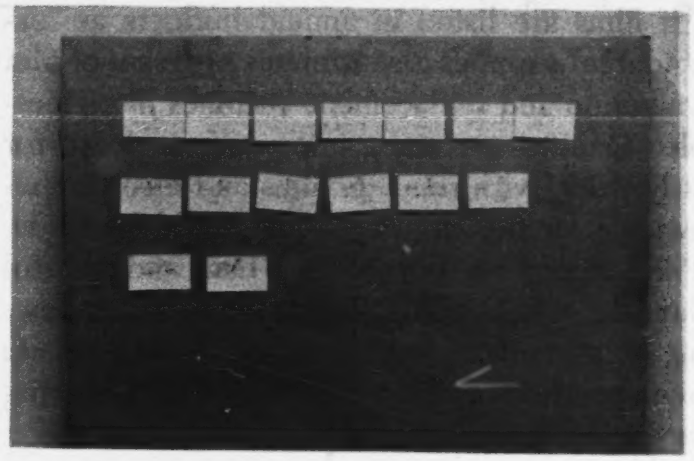
laboratory technique is actually to instruct an untrained student in the technique and see how much time is required. Many film scenes can be shorter than the "live" demonstration by removal of such time-consuming aspects as the major part of a titration sequence or the recording time of an infrared spectrophotometer during which no absorption is occuring. Thus, the timing of an actual demonstration provides only a maximum figure. The minimum timing is then obtained by elimination of "non-instructional" periods in the demonstration. Another procedure is to shoot a few scenes, preview them with students, and observe their reaction to the timing.

If narration is to accompany the film, it is wise to tape record a sample narration during a "live" run-through. The tape can then be replayed and non-essential comments removed. Each scene must then be designed to be of adequate length for the accompanying narration unless "stop-frame" adaptations are planned for the projection of the completed film. A written copy of the "edited" narration can prove useful in final planning of the film, in its showing, and in adding sound, if this is desired.

2. The Storyboard

An extremely effective planning aid in film preparation is the so-called "storyboard," an arrangement of cards and photos (or sketches) of individual components of the film. Each separate title, scene, or basic shot is recorded on a 3″ x 5″ card, or Polaroid photo. The proposed camera time for each is recorded on a corner of the photo or card, and the set is arranged in the sequence to be used in the final film. Once the storyboard is assembled it becomes easy to determine whether additional material is needed or superfluous material can be deleted. Timing of the completed film can also be estimated. Each different camera shot* planned should be included, preferably as a sketch (or photo), and the effectiveness of each shot can be estimated for any necessary modifications.

For films involving demonstration of laboratory techniques, it is possible to substitute an "audio storyboard" for part of the preceding material by tape recording the narration accompanying a "live" demonstration of the technique, but scene sketches should still be included for best planning.



Storyboard using sketches or photos and 3″x5″ cards thumbtacked to 3′ x 4′ fibreboard

If videotape equipment is locally available at low cost, it is quite useful to prepare a "rough draft" of the planned film on videotape for comments by available "experts" on subject matter content and visual techniques before the color film itself is actually made. Inexpensive ½″ videotape equipment* is quite satisfactory for this purpose.

Once the film is completed, the storyboard cards and photos should be stored so that changes indicated after a reasonable period of film use can be made without "starting from scratch."

The best-made plans are subject to improvement and the flexibility inherent in "amateur" filming should be exploited at every opportunity. That is, once filming has begun it is likely that a scene will appear different in the camera viewfinder than anticipated.** Appropriate changes should be made to improve the scene, or alternate scenes can be filmed and the best ones selected in editing. As experience in film making is accumulated, the necessity for detailed planning, at least for films of similar type, becomes less, and more "spontaneous" work becomes feasible. Viewing of films already available on a

*See section D.

*For example, see Modern Teaching Aids for College Chemistry (AC_3 Serial Publication 18).

**The chemist is invaluable as cameraman in obtaining proper film shots, since he will be most aware of what the student should see.

topic is invaluable in planning a local adaptation of the instructional film.

B. OBTAINING CONSULTANTS

1. Content

Since instructional films in chemistry are primarily "teaching aids" and only secondarily "works of art," it is most important that professional colleagues be involved in the determination of the film content. One excellent device for accomplishing this is to enlist the aid of students in serving as "cast" for the film, and scheduling a "dress rehearsal" of the film after it has been planned with as much prior consulting with colleagues as possible. Students then walk through the scenes of the film and discuss the narration and planned sequence of "long shots," "closeups," etc. for an audience of interested faculty and other students. Minor errors in technique or content can thus be caught before the material is committed to film.

2. Technical Help

Most chemistry teachers have little or no prior experience in making movies and may well profit from some technical advice. The first source to be tapped is the local audiovisual department, a group whose contributions have too frequently been ignored by chemistry departments in the past. A second source of help is the local camera club, which can usually be contacted through a camera dealer. Frequently members of this club with home-movie experience are happy to spend a few hours consulting with prospective film makers.

3. Source Books

A number of booklets can be obtained, usually through the camera shop, which contain useful hints for the production of films. In particular, the following booklets, which have been valuable references for this report, are highly recommended.

a. "Industrial Motion Pictures," 1st edition, Eastman Kodak Publication No. P-18 ($1.00)
b. "How to Make Good Home Movies," Eastman Kodak Publication No. AW-3 ($1.25)
c. "Basic Titling and Animation," 1st edition, Eastman Kodak Publication No. S-21 ($1.00)
d. "Planning and Producing Audiovisual Materials," 2nd edition, Jerrold E. Kemp, Chandler Publishing Co., San Francisco, 1968 (about $9.00)
e. "Planning and Producing Visual Aids," Eastman Kodak Pamphlet No. S-13, single copies free on request from Eastman Kodak, Motion Picture and Education Markets Division, Rochester, N.Y. 14650.

C. BASIC EQUIPMENT

Before purchasing film equipment it is necessary to decide whether 8mm or super 8 films* are preferred. It will be worthwhile, if these media are unfamiliar, to visit a camera dealer for viewing some sample films of both types.** It is not the intent of this report to suggest a single alternative as being the best, since both have advantages. The regular 8mm format is somewhat less expensive, whereas the super 8 provides better picture quality, larger picture size, and more "professional" appearance when projected. Unless regular 8mm equipment is already owned, it will be advantageous to investigate super 8, since the latter appears to be the more likely format used for most new developments in cameras, projectors, and other equipment.† Both types can be used for endless-loop cartridge projectors or reel-to-reel projectors with or without sound.

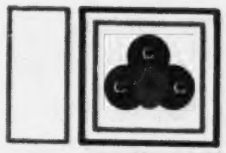
There are many advantages, especially when multiple copies of a film are needed, in shooting the original on 16mm and obtaining release prints in 8mm or super 8.‡ Since it has been the authors' experience that the quality of 8mm or super 8 films (i.e., shot directly, not reduced) is more than adequate for instructional purposes and the production of such films is far less expensive and considerably simpler than in 16mm, this report will not be concerned with 16mm work.

*For information on the film type referred to as "Single 8," consult a camera dealer.

**Comparisons may also be made by borrowing an 8mm and a super 8 film kit from the Advisory Council. Write: "Films," Advisory Council on College Chemistry, Department of Chemistry, Stanford University, Stanford, Calif. 94305.

†See the following news release from Technicolor Corporation: "Technicolor has authorized its audiovisual dealers, starting September 1, 1967, to offer schools that have purchased standard 8 Technicolor projectors the opportunity to trade in their standard 8's for new Technicolor super 8 silent projectors. This program provides schools with an opportunity to have the most advanced equipment plus standardization of one 8mm film format. In addition, many film producers are offering a parallel print trade-in program, because they also recognize that a standard must be set in the 8mm film format."

‡See the following release from Eastman Kodak Company.



A Note on the Use of Super 8 Film and Equipment for Original Production

The enthusiastic reception of the KODAK INSTAMATIC Movie Cameras has been due to the many very attractive features of these cameras — their compactness, small size and light weight, convenient and easy loading, automatic exposure control, motor drive, and other advantages. Among the satisfied users of this new equipment are many educators, audiovisual directors, and specialists who have realized its great potential for the making of motion pictures to be used in education at all levels. The cameras seem particularly suitable for the production of short single-concept films on a wide variety of subjects.

Contributing in no small measure to the acceptance of this equipment has been the adoption of the super 8 format and the excellent characteristics of KODACHROME II Movie Film, Type A. The high definition, excellent brightness, and full color saturation of the projected pictures have been so impressive that many people are envisioning a complete system with the super 8 film used as the camera film and numerous prints being made from this original.

There are some problems inherent in this idea, since the quality of prints made from a KODACHROME II original may fall short of acceptable standards. The material most commonly used for making prints from such originals is another reversal color film, somewhat similar in structure and processing requirements to KODACHROME II. This print film, designated EASTMAN Reversal Color Print Film, Type 7387, is intended for, and most extensively used for, the preparation of 16mm prints from low-contrast 16mm camera originals, such as EKTACHROME Commercial Film, Type 7255 (commonly used in 16mm professional motion picture work). The Type 7255 product is not, however, suitable for use in 8mm cameras and is therefore not available in the super 8 size.

When originals that have good projection contrast, such as films made on KODACHROME II, are printed on Type 7387, there is a substantial increase in contrast in the resulting print. A loss of detail in extreme highlights and deep shadows may result from this increased contrast. In addition, certain scene elements may be rendered darker than in the original and some hue shifts may occur. Whether such departures in the reproduction are tolerable depends to a great extent on the particular subject matter, on the reflectance values of the scene elements, and, of course, on the lighting contrast used in photographing the original scene. From the standpoint of sharpness, the print may be very acceptable if the original footage is critically sharp and good contact between the original and the print film has been maintained during the printing operation.

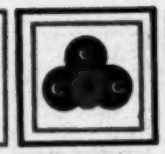
For these reasons, you cannot expect that the print will be as high in quality as the original when you make a reversal super 8 contact print from a super 8 KODACHROME II original. Nevertheless, a number of people have felt that such prints serve a useful purpose and are often acceptable for the particular projects for which they were made. It is best in most cases to have a trial print made and then decide whether multiple print should be produced. If you follow this procedure, be sure that your decision is made before any damage to the original has occurred. Remember that scratches and imbedded dirt may result from repeated projections and these defects will reduce the quality of the print that is perhaps already marginal.

Another consideration is the matter of incorporating special optical effects — fades, dissolves, wipes, and so forth. At the present time, most laboratories do not have facilities for introducing such effects during the contact printing of super 8 originals. The finished print would therefore present only a straight scene-to-scene sequence without the embellishments seen in more professional productions.

It is hoped that future improvements in laboratory equipment and print material will provide solutions to these problems, thus making the super 8 system more amenable to a complete production system. However, such developments appear to be very unlikely in the near future. For the present, therefore, where it is known that multiple prints of high quality will definitely be required, the best approach is to plan the production for original photography on 16mm EKTACHROME Commercial Film and then have multiple reduction prints made by a commercial laboratory. A number of laboratories can now provide such service, using one of several established procedures.

The following suggested equipment list will provide all the basic items needed for an instructional film program in chemistry, with the exception of special apparatus which might be required for rarely-encountered needs such as microphotography. Special problems may best be handled by consulting major film and camera company representatives. All prices quoted are approximate only.

Equipment items actually used by the authors and found quite satisfactory are underlined. Some representative brands of alternate equipment are listed. The authors do not imply that the equipment they used is the best available, but only that they recommend it as being satisfactory. No attempt is made to give an exhaustive equipment list or a "Consumer's Report" evaluation. Specific desirable features for each type of item are indicated and should be considered important, whatever brand of equipment is actually purchased.



1. EQUIPMENT FOR MAKING 8mm FILMS

Item	Approximate Cost	Desirable Features	Representative Examples
Camera	$150-$300	Through-the-lens viewfinder, zoom lens, single frame setting, variable filming speeds, automatic/manual exposure control.	**8mm: Revere Model 153, Bolex H8,** Bell and Howell Autoload 418; **Super 8: Kodak Instamatic M-8, Kodak Ektagraphic 8,** Minolta Autopak-K5, Nikon Super Zoom 8. Canon 814 (in-camera-fade).
Auxilary Lenses	$ 10-$ 50	Must fit camera lens used. Should have at least 2+ and 4+ lenses. Consult camera dealer (a).	Tiffen lenses, Spiratone lenses, Vivator lenses, Ednalite lenses.
Lightmeter (b)	$ 5-$ 30	Available as either "incident" or "reflected" type. Latter often preferred for closeup shots.	Kalimar auto-dial, Norwood super director, **Yashica YEM-55.**
Tripod Stand	$ 15-$ 60	Tilthead, panhead, medium weight, wobble-free.	**Hollywood Jet General, Quick-Set Husky IV,** Spiratone Heavy Duty.
Remote Cable Release	$ 3-$ 10	Must fit camera chosen; should be at least 18" long.	See local camera dealer.
Movie Lights	$ 20-$ 30 each	Should have **three.** Must have correct "temperature" for color balance (3400K), preferably quartz-iodine or quartz-bromine type bulb. Should have clamp for mounting on light stand.	**Kodak Instamatic Movie Light—Model 2, Smith-Victor Q-1-P Movie Light.**
Light Stands	$ 10-$ 25 each	Should have two or three. One light may be mounted with the camera.	**PIC Light Stands.**
Titling Sets	$ 3-$ 15	Preferably white or light colored letters for use on black background **or** black letters for light background.	**Hernard Dimensional Letters, Press-Type Letters.**
Film Editor	$ 25-$ 60	Should be tried in advance to see that picture is well lighted, film is not overheated, and there are no places where film scratching occurs. Specify 8mm or super 8.	**8mm:** Argus-Model 767, Mansfield Reporter-Editor 2008. **Super 8:** Argus-Model 768, **Mansfield Reporter Super Eight Model 2080.**
Splicer (c)	$ 4-$ 25	May use splicing tape or cement according to preference; should have spring fingers to hold film in place.	**Kodak Presstape Universal Splicer** (16, 8 or super 8), Victor Splicer VS-6 (16, 8 or super 8; cement or tape).

(a) For specific advice on lenses, see "Close-Up Movies," Kodak Pamphlet No. AD-30, free on request from Consumer Markets Division, Eastman Kodak, Rochester, N.Y. or free booklets on Vivator or Steinheil lenses from Ponder and Best, Inc., 11201 W. Pico Blvd., W. Los Angeles, Calif. 90064.

(b) Some of the newer cameras have only automatic exposure control, in which case no additional lightmeter is required.

(c) Some editors are equipped with built-in splicer.

2. MISCELLANEOUS SUPPLIES NEEDED FOR MAKING INSTRUCTIONAL FILMS

Film: Regular 8mm, Kodachrome II, Type A, about $2.50 per 50 ft.; super 8, Kodachrome II, Type A, about $3.00 per 50 ft.; many other types available.

Processing: Prepaid processing mailers to Eastman Kodak — $2.10 for 50 ft.; other processors available (a).

Splicing Materials: Tape or cement, about $1.00.

Spare Bulbs: For editor and lights, about $15.00.

Batteries: For camera, about $1.00.

White Gloves: (cotton) for handling film, under $1.00.

Dulling Spray: Spray No. 700, Blair Air Products, Inc., Memphis, Tenn., about $3.00.

Background Material: TV Gray Matte Paper or Light Tan Burlap, about $5.00.

Ten-foot Tape Measure: For setting camera-to-subject distance, about $1.00.

General Supplies: 3′ x 4′ fibreboard, 3″ x 5″ cards, map pins, various colors of poster-paper, notebook, about $3.00.

(a) See Appendix E.

3. PROJECTION EQUIPMENT
(Representative List)

(For sources, see Appendix B)

Item	Manufacturer or Distributor	Description	Approximate Price
Regular 8mm	Brumberger	Simple, home-movie type, 300 watt bulb	$ 40
	Kodak	Automatic threading, 150- watt bulb	$ 60
	Sears, Roebuck & Co.	Several models	$ 90-$130
Sound Adaptors	Bolex	Synchronizes any 3¾ ips tape recorder with Bolex projectors	$140
	Sears, Roebuck & Co.	Uses magnetic stripe on movie film, records and plays back, fits most 8mm sprocket-drive projectors	$ 40
Regular 8mm Sound	Eumig	Magnetic-striped film, record and playback	$320
	Sears, Roebuck & Co.	Magnetic-striped film, record and playback	$200
	Pathe	Operates with external tape recorder	$170
	Viewlex	Optical and magnetic sound, playback	$350
8mm Cartridge	Technicolor	Various types available	$ 80-$200
	Fairchild	20-minute loop, magnetic sound, playback only or record and playback (Mark IV-RV)	$560-$770
super 8 Reel-to-reel (silent)	Argus	Various types	$ 80-$130
	Bauer	Can be synchronized with tape recorder	$180
	Bell & Howell	Various types, silent	$100-$200
	Kodak	Various types	$ 60-$200
	Sears, Roebuck & Co.	Various types, some of which can accept sound adaptor	$100-$160

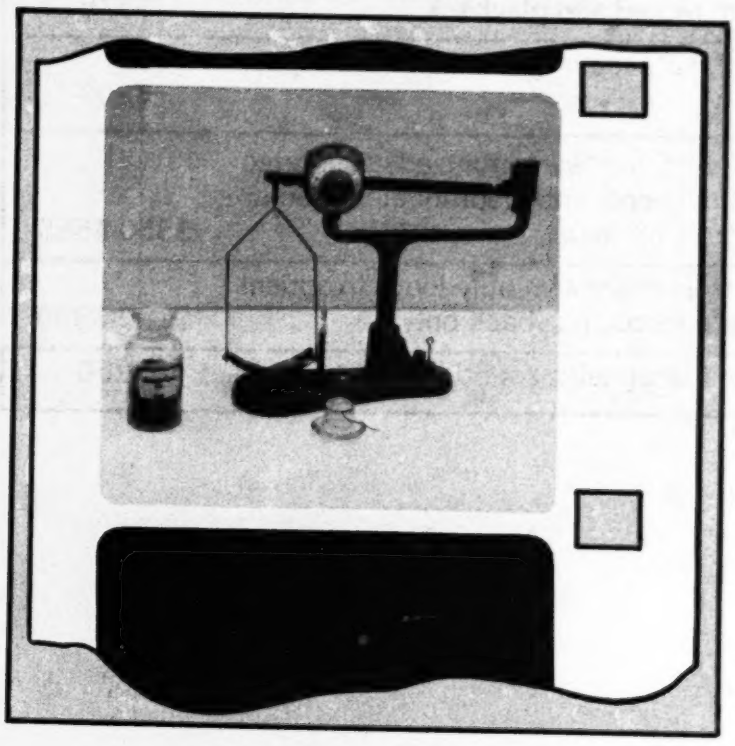
3. PROJECTION EQUIPMENT(Continued)

Item	Manufacturer or Distributor	Description	Approximate Price
super 8 Reel-to-reel sound	Carena	super 8 or regular 8, magnetic sound, record and playback	$600
	Eumig	Magnetic sound, record and playback	$350
	Bolex	Magnetic sound, record and playback	$380
	Kodak	Magnetic sound, record and playback	$575
		Magnetic sound, auto loading, student-carrel type, playback only	$200
super 8 Cartridge	Audion	Cartridge-loaded film, synchronized cartridge audio tape, film speed and additional projector automatic controls optional	$350-$565
	Technicolor	Various types, from silent 4-minute loops to optical sound 30-minute loops, playback only	$130-$300
	Jayark	30-minute loops, magnetic sound, playback only	$250

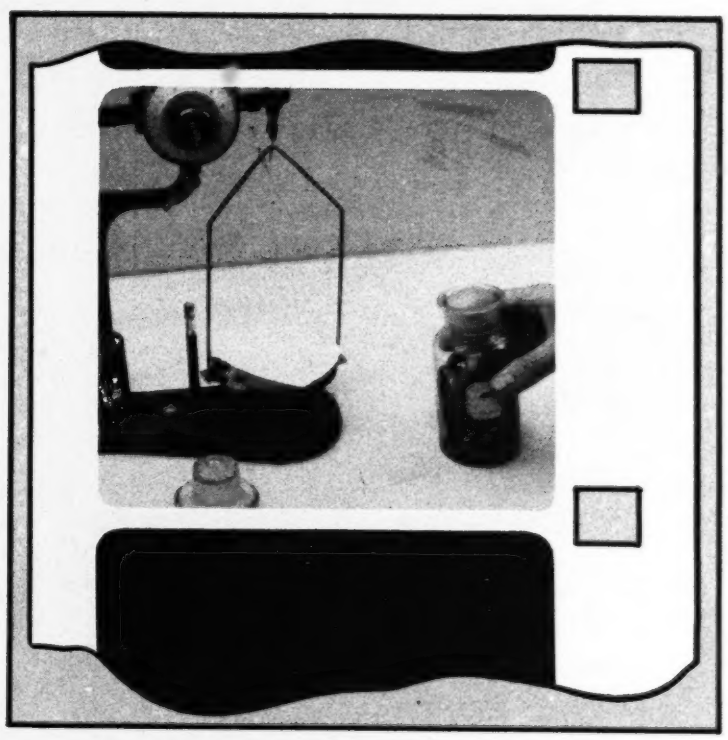
D. COHERENT FILMED INSTRUCTION

1. Basic Camera Shots

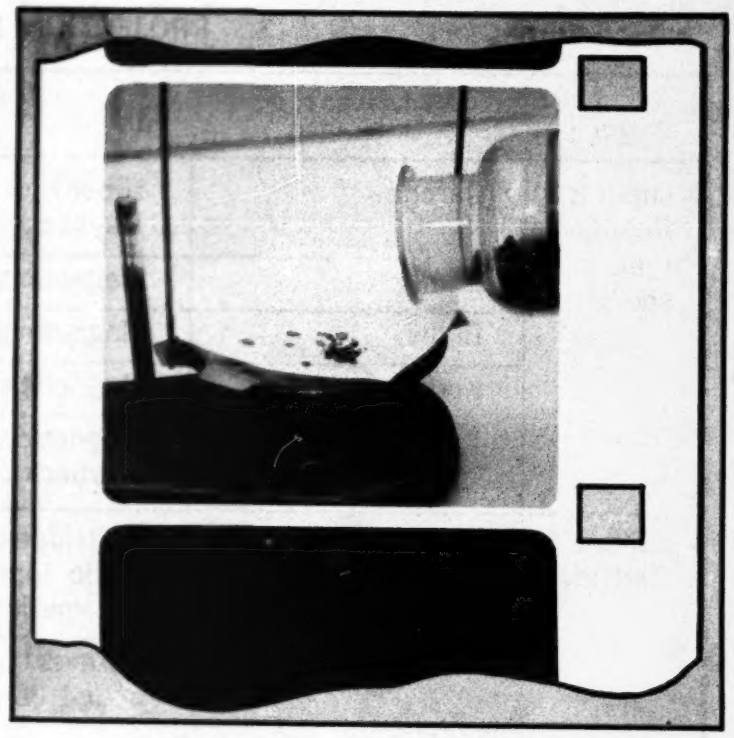
Orientation to the general setting of the topic should occur first, usually with a "long shot" of the complete laboratory set-up or appropriate introductory scene.* This orientation shot should run long enough to scan the entire setting and form a mental frame of reference.



Long Shot



Medium Shot



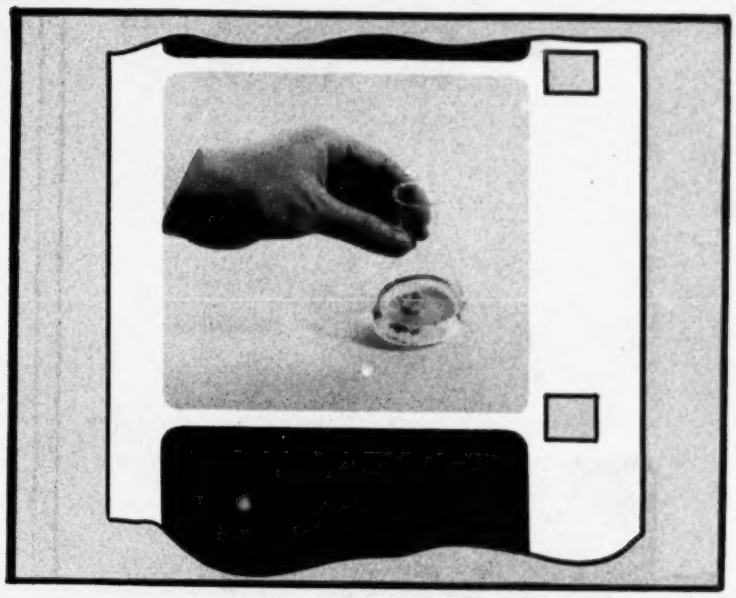
Closeup

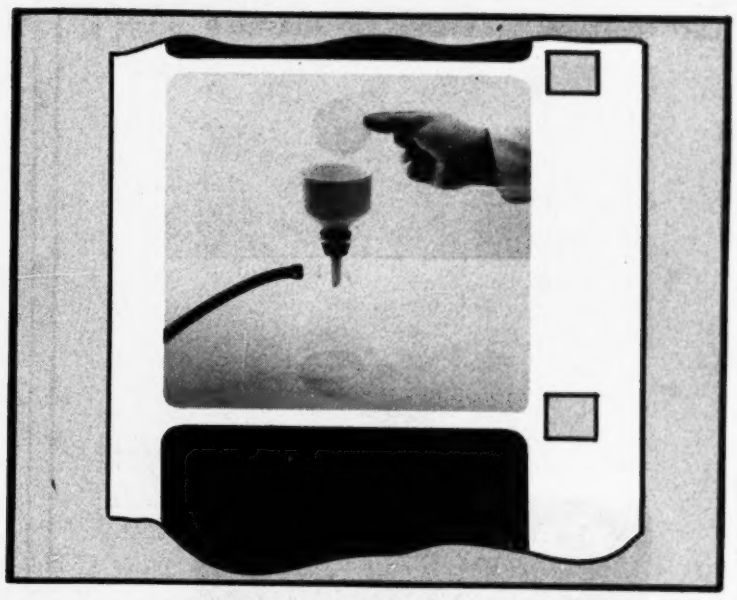
Three fundamental camera shots used to establish setting, show area for action, and concentrate on action of major importance.

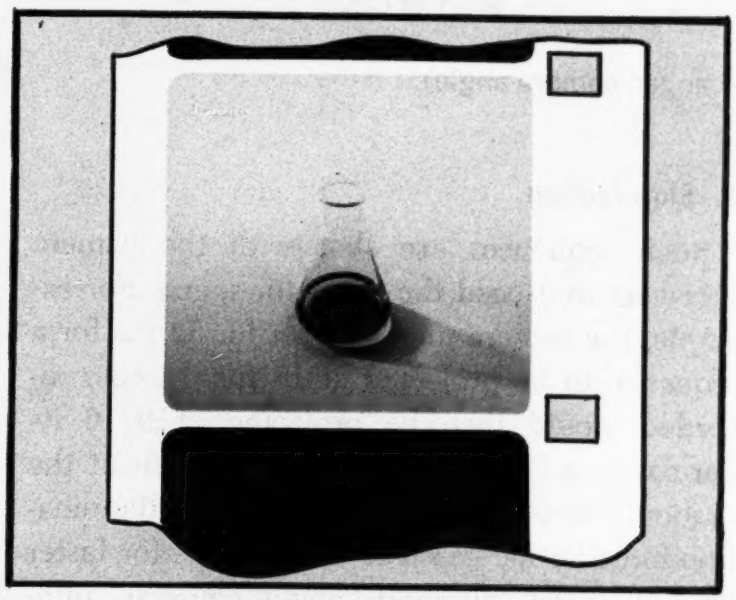
Once orientation is established, the camera may be moved closer or "zoomed in" for a "medium shot" of the section in which initial action is to occur. Finally, a "closeup" of the really significant action is made. Since a major advantage of instructional film is to bring the action into optimum size for all viewers, maximum use of close shots should be planned.

Rigid adherence to this series of camera shots should be avoided if the film is to have a "professional" flavor. Variations include "zooming" from close to medium shots (although too much "zooming" is considered the mark of an amateur), stopping the camera for a variation of camera angles on the same basic scene, or use of a "meanwhile" shot, such as a sequence of arranging filtration equipment interposed between closeups of crystallization of an organic solid from its solution or a series of title frames stating "Titration is continued" interposed between the beginning and final shots of a titration sequence.

*For laboratory-technique films it is recommended that some initial "footage" be used to show a pair of hands reaching for and opening up a set of safety glasses, then removing them from the scene for obvious (off camera) use as eye protection.







A "Meanwhile" Transition

2. Continuity

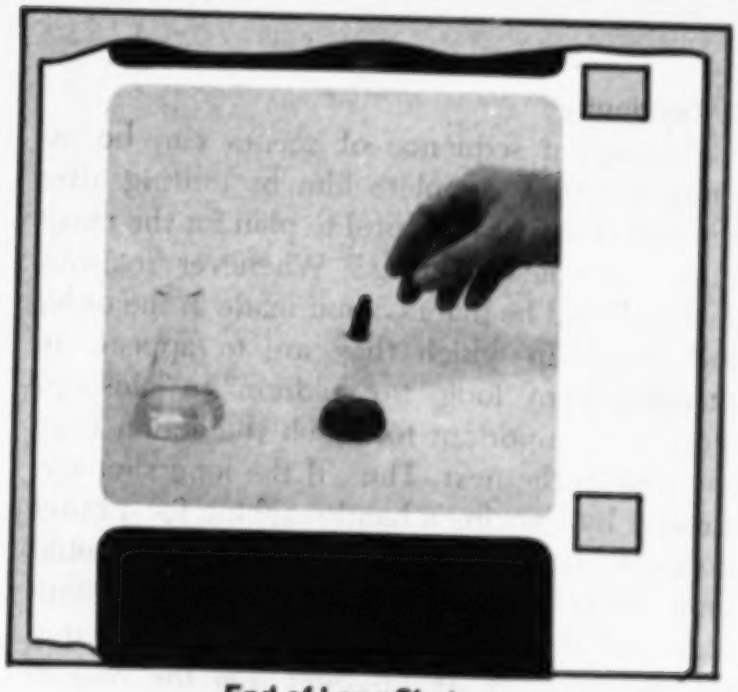
Although a sequence of scenes can be assembled into a complete film by editing after film processing, it is helpful to plan for the maximum "in-camera editing." Whenever feasible, scenes should be planned and made in the order and length in which they are to appear. In changing from "long" to "medium" to "closeup" shots, it is important to match the action from one shot to the next. Thus, if the long shot terminates by showing a hand reaching for a buret stopcock, the medium and close shots should show, successively, the hand grasping the stopcock and the stopcock and fingers completing the operation. *It is important that the camera angle be changed somewhat in progressing from one shot to another to avoid an appearance of "jerkiness" in the projected film.*

When scenes are shot out of order it is useful to snap a Polaroid photo or make a notebook record of the closing of a scene so that the opening shot of the next scene to be eventually added can retain a satisfactory continuity.

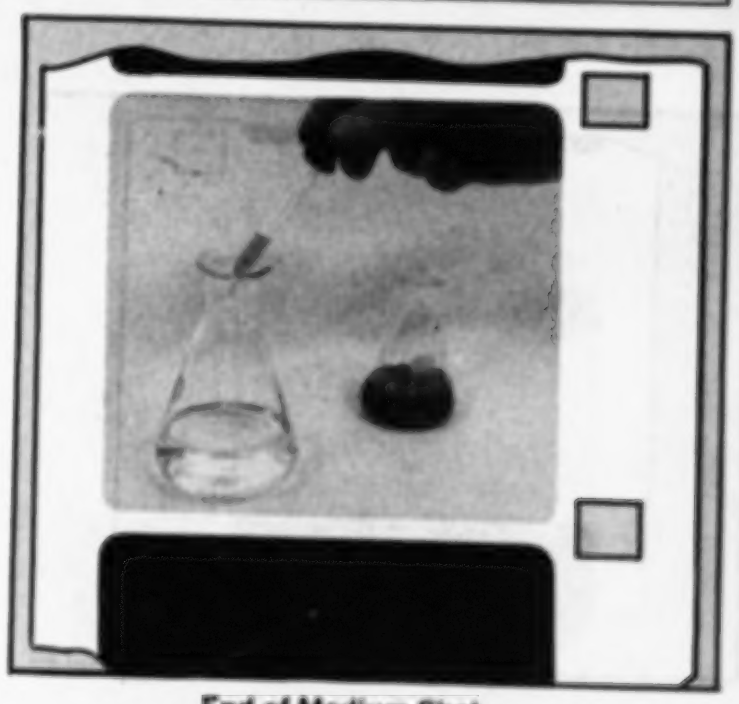
3. ANONYMITY

To produce a film which will be useful for a variety of sections or levels of presentation, it is essential to preserve "cast anonymity." Operations should show hand manipulations, equipment in motion, etc., but full shots of individuals should be avoided. If a person, as such, must be included, it should be clearly shown that he is simply performing some essential task (and definitely not talking) while the instructor (unseen) is describing the procedure. Clothing should be checked for continuity and contrast, using, if possible, a neutral tan laboratory coat routinely. It is best to remove all jewelry (including watches) from hands to minimize distraction and possible glare and to make it less obvious whenever a new person's hands are involved.

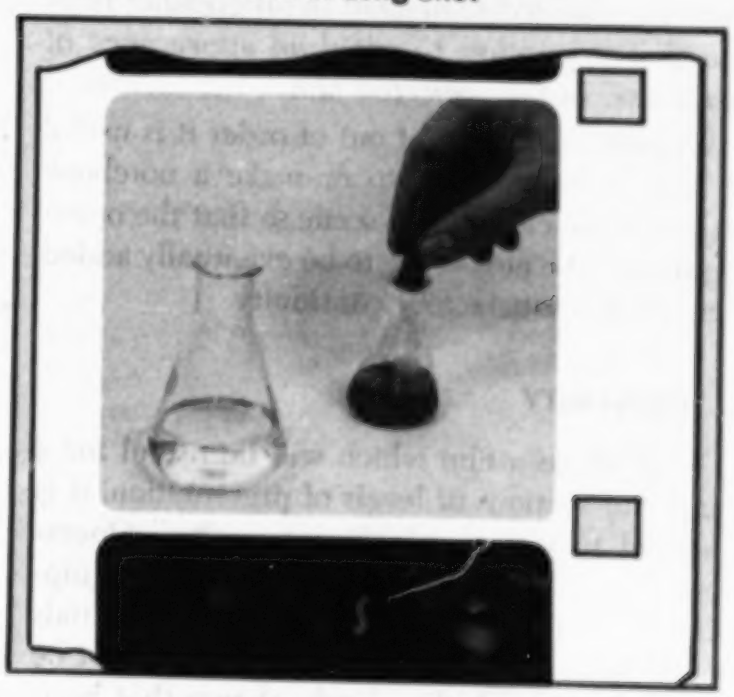
Except for rare cases where a highly contrasting background is needed, the background color (light grey or tan) used should be the same for an entire film program. This will permit splicing sequences from one film to another without noticeable change.



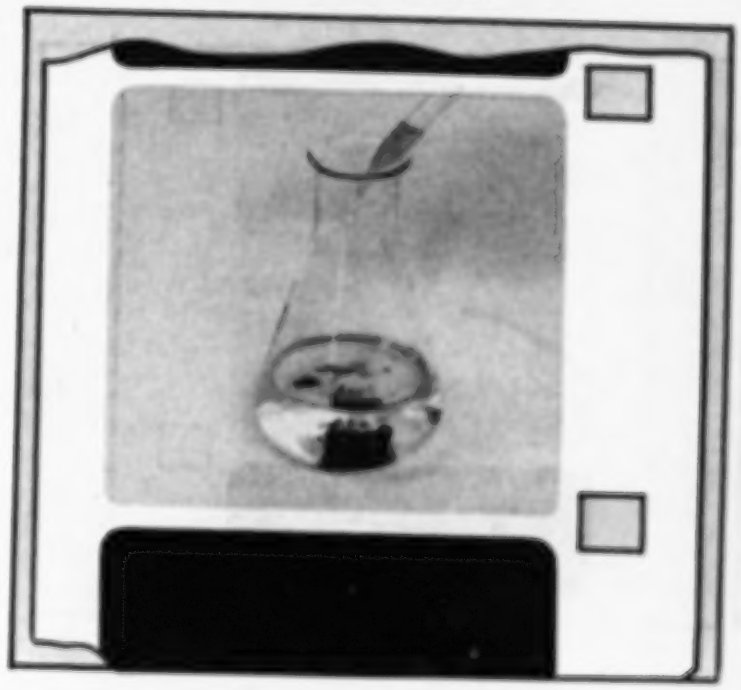
End of Long Shot



End of Medium Shot



Start of Medium Shot



Start of Closeup

Matching action shots (Note changed camera angle)

E. FILMING SPEEDS

Most cameras in the price range above $150 will have more than one possible filming speed. The typical speed for a silent film is 18 frames per second (fps) and that for a sound film is 24 fps, although adequate sound quality is possible with magnetic sound at 18 fps.

Usually instructional motion pictures in 8mm or super 8 should be filmed at 18 fps, unless they are intended for commercial release with sound. Other filming speeds are then used for one of the following special purposes:

1. Slow-motion

Such sequences are shot with the camera speed set to exceed the projector speed. For example, the camera might be set for 32 fps for a sequence to be projected at 18 fps. Motion recorded would then be projected at 9/16 its normal speed for more effective analysis of the motion. Often, the lens aperture or set illumination must be increased to compensate for faster filming speed, although many cameras automatically make such compensation.

2. Time-lapse

This technique is the opposite of slow motion, i.e., camera speed is set to be slower than projector speed. An example of such an effect would be filming, at 12 fps, the recording of an infrared spectrum for projection at 18 fps. In such a case, viewing time would be reduced to 2/3 that required for the "live" observation. Special devices can be constructed or purchased to shoot single frames or short bursts at intervals of four seconds or longer for time-lapses where several hours of action must be compressed into a few seconds of film time. When such sequences are only rarely encountered a satisfactory substitute is a student employee who sits by the camera, which is rigidly clamped in position, and manually advances the film by the required number of frames at a set time interval. A special use of time-lapse photography is involved in simple animation and is discussed in a later section.

F. THE "SET" AND LIGHTING

1. Background

The background for a motion picture scene is generally best when it is least conspicuous. Background material should be selected, usually, for neutral color – contrasting somewhat with the items to be photographed, but not distracting in any way. A very light tan or grey material of roughened texture is quite useful for most scenes and can be prepared from burlap or similar fabric or from a TV gray matte paper supported on fibreboard. A curved joint between wall and table is essential in reducing distraction from a sharp dividing line and the same fabric can then be used for both the back and bottom of the set. Occasional use of colored paper for a specific contrast is good, but any background colors must be chosen carefully so that they do not draw attention from the scene itself.

Typical Simple Set

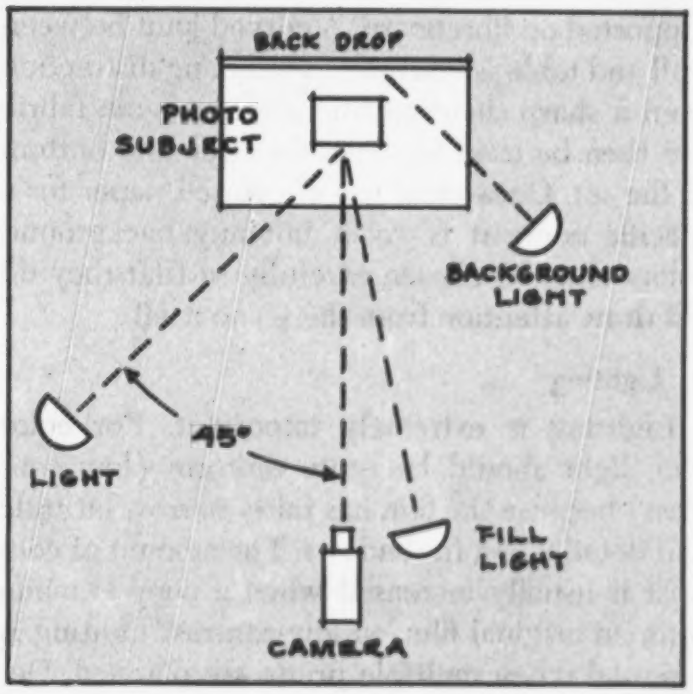
2. Lighting

Lighting is extremely important. For color film, light should be quite uniform (low contrast) because the film has fairly narrow latitude and detail is lost in shadows. The amount of contrast is usually increased when a copy is made from an original film, so low-contrast lighting is essential when multiple prints are planned. Deliberate planning of shadows for special purposes may sometimes be worthwhile, but it must be remembered that such an effect will be even more pronounced on duplicate prints.

Photoflood lamps may be mounted in simple floor stands or small, lightweight halogen-cycle lamps (e.g., quartz-iodine) may be obtained for mounting on inexpensive light stands. Lamps should be selected to have a proper color "temperature," preferably 3400 K. The positioning of the lights will vary somewhat with the scene, but in general should be such as to provide a minimum of shadow and to avoid glare from metal or glass objects.* Some types of cameras have sockets for mounting movie lights; for those which do not, one light ("fill" light) should usually be placed almost overhead to the camera but about 10° to 15° to one side. A second lamp (key light) should then be set about 45° to the other side of the camera. If a third lamp is used, it should be positioned near the set and high to "wash out" shadows on the background.

Movie lights require a great deal of current and should never be used with "light-duty" extension cords or on circuits whose power rating is unknown. For example, three typical quartz-bromine lights would require a 20 ampere load, i.e., fuse or circuit breaker in the line should be

*On occasion it may prove necessary to spray glass or metal objects with glare-reducing spray (dulling spray) available through most camera dealers.



Typical Light Arrangement

rated at least 20 amperes and no other electrical "drain" on such a circuit should occur while the lights are in use. Specific requirements of lights actually selected should be determined.

3. Camera Exposure Settings

In order for film to be properly exposed the f/ number of the camera lens must be set correctly according to the light in the scene. A light meter is used to measure the light level. Many newer cameras include a built-in light meter which automatically sets the f/ number. This may be satisfactory for longer shots but when filming a closeup scene a highly reflecting table top or object may cause a false camera setting. Experience may guide you to vary the camera setting if possible under such conditions.

A separate light meter is preferred for accuracy in determing exposure. Either an *incident* type (held at the subject and aimed toward the camera) or a *reflected* type (held at the camera and aimed toward the subject) can be used. The meter requires a setting for film speed (for example, ASA 40 for Kodachrome II, type A) determined from the film data sheet. The needle of the photoelectric cell in the meter indicates light level. This is set on the meter dial opposite the camera shutter speed (for example, 16 or 18 frames per second or 1/30 of a second). The resulting reading is the f/ number setting for the camera lens.

When manual exposure settings are to be made (i.e., automatic exposure on camera not used), only the main light and "fill" light(s) should be on during use of the lightmeter. The background light, if set on the background only, will not influence the frontal illumination on the subject.

G. TITLING

Proper titles will improve almost every instructional film. As a minimum, the name of the film, a copyright statement, and credits to participants should be included. Titles may also be useful, especially with silent films, to clarify action, break up lengthy scenes, or add information or data. To assure legibility, titles should be as large as possible* and should usually contain fewer than thirty words. They should appear on the screen long enough to be read aloud. Only initial or final titles should contain "decorations," since such frills will detract from more instructional scenes. Some simple techniques of titling are indicated below.

1. The Animated Title

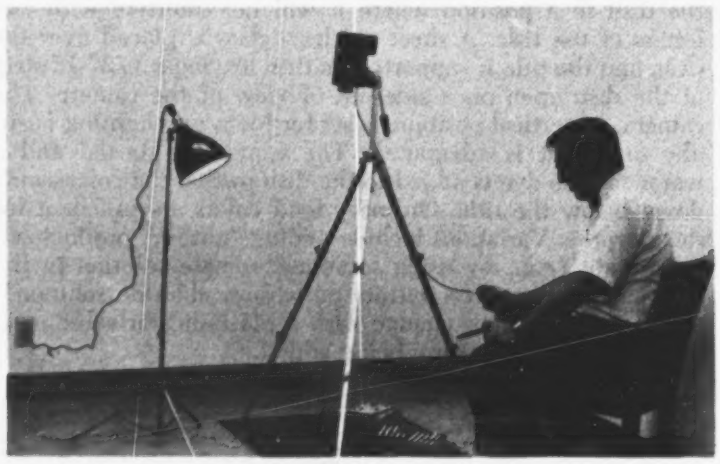
One letter of the title is placed on an appropriate background supported on the floor. The camera is mounted securely on a tripod in a vertical position and appropriate settings are made for lighting and focusing. If thick letters** are used, the light can be set slightly to one side to create small shadow effects. Two or three frames (or a short burst) are shot, using a remote cable release to avoid small camera movements. The next letter is added and "shot" in the same way and the process is continued until the entire title is filmed. Then a few seconds of film should be run of the completed title.

2. Separate Title Frames

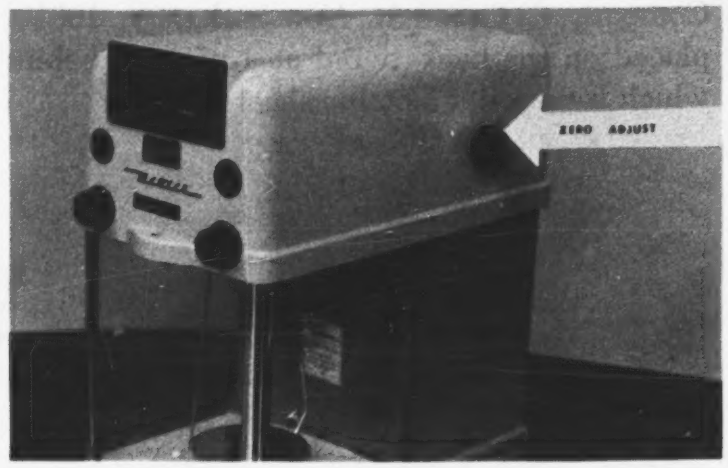
If the descriptive titles are to occupy separate film space, i.e., they are not superimposed on

*For example, titles prepared on an 8-1/2" x 11" sheet of backing should use at least 1/4" high letters for optimum visibility. For more detailed suggestions, see "Legibility Standards for Projected Material," Eastman Kodak Pamphlet No. S-4.

**Available from Charles Mayer Studios, Inc., 776 Commins St., Akron, Ohio 44307; Mitten Display Letters, 345 - 5th St., Redlands, Calif. 92373; Hernard Mfg. Co., 21 Sawmill Road, Yonkers, N.Y. 10701; or from many local camera dealers.



Animated Titling



Use of "Tag" Titles

scenes, the procedure is quite simple. The titles can be made with any of a variety of lettering methods*, or "spontaneously" by vertical shooting onto appropriate background with plastic or cardboard letters simply laid in position. The complete titles for an entire film can thus be shot in sequence on a single film and spliced into the final production during editing. If white letters are to be used, a black background is desirable, whereas colored or black letters should use the same background as used in the set itself to maintain continuity.

3. "Tag" Titles

For descriptive ("tag") titles for individual parts of a scene, e.g., identification of the various knobs on a single-pan balance, the titles may be printed on small white arrows and affixed to the proper spot by tape or held in position by fine, stiff wire. If the camera is stopped as each such title is added or removed, the film produces the illusion of a "magic" appearance and disappearance of the title.

4. Superimposed Titles

Three methods are commonly used for superimposing titles in 8mm filming. In cameras using film on rewindable reels,** the scene may be filmed first, then the film may be rewound to the appropriate spot and a set of white titles on black background can then be shot. This method is rather tricky as it is essential that the writing appear in the final picture in some segment where it will be easily visible without obscuring any important part of the scene. For this reason, it is usually desirable to film the title immediately after filming the scene so the position for the title to appear is freshly in mind.

A second method is to use a half-surfaced mirror arranged for the titles and scene to be shot simultaneously.* Lighting must be carefully controlled on both the scene and the titles. For details, write Evaporated Metals, Inc., Ithaca, N. Y.

The third, and easiest, procedure uses overlay titles placed on a sheet of glass set immediately in front of, behind, or beside the scene and as close to it as possible. "Press Type" letters may be used on the glass or plastic or cardboard letters may be glued to the glass.** Lighting must be adjusted to avoid glare. A variation of this method employs letters mounted on an acetate sheet, which is pinned inconspicuously to the background. A second variation uses magnetic letters (source: Magna Chart System, 1200 N. Rockhill Rd., St. Louis, Mo., or Madison A-V

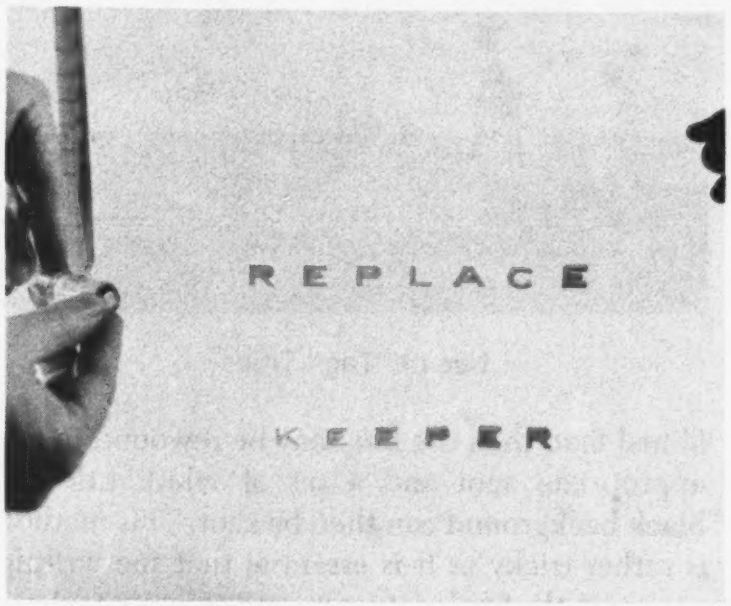
*For example, a very rapid method of preparing neat titles uses transfer letters available on thin sheets. The letters are transferred onto the desired background or onto clear acetate sheets for overlays by placing the appropriate letter in the desired position and rubbing it with a ball point pen or other burnishing tool. Two such lettering sets are: PRESTYPE, available from Prestype, Inc., 136 W. 21st St., N.Y., N.Y. 10011, and LETRASET INSTANT LETTERING, available from A. Brown and Bro., Inc., 2 W. 46th St., N.Y., N.Y. 10036. Both types are frequently for sale at camera or art stores.

**Cartridge-loading cameras cannot usually be rewound.

* An alternative is the "matte box" arrangement. For details, request Technical Information Bulletin No. 38-5 (Matte Box) from Paillard, Inc., 1900 Lower Road, Linden, N.J.

**Adhesive dimensional letters such as those made by Hernard Mfg. Co. are most useful for this purpose.

Company, 62 Grand St., New York, N.Y., 10013) placed on the background at a position behind which is placed a metallic sheet.



Use of Overlay Titles

5. Decorative Titles

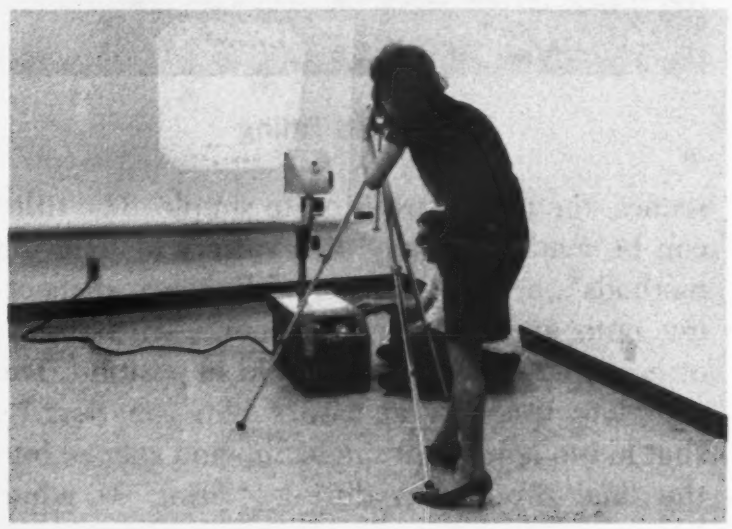
As has been mentioned earlier, decorative titles should be used only for initial or final titles to avoid attracting attention from instructional material. Such titles are in no way essential to the informational purpose of the film, but may prove enjoyable to the film producers and add a certain "professional" quality to the finished product. Two suggestions are indicated below and a little "artistic ingenuity" can easily lead to other techniques.

a. The "Scroll" Title

The entire title, credits, and copyright statement are prepared in advance on an acetate roll for an overhead projector. The letters may be black or colored and can easily be prepared using lettering stencils and wax pencils designed for overhead projectors. The camera is set on a tripod in horizontal position and the overhead projector is focused on a background of suitable color. The setting for the initial scene may be placed in front of the background if desired. The projector itself supplies all the light needed. The proper light and focus adjustments are made on the camera and shooting is begun. The titles, previously mounted on an acetate roller on the projector, are rolled forward slowly until each is centered in the viewing area, allowing adequate time for each line to be read aloud before the next is advanced.

b. The Swirling Background

The titles are prepared in advance on transparent acetate sheets (e.g., reclaimed X-ray film), using letters made as previously described. A magnetic stirrer is placed on the floor under a piece of 12" square backing (e.g., burlap-covered masonite supported at the corners by wooden blocks). On top of this is placed a deep rectangular glass baking dish containing about 1/2" of water. A magnetic stirring bar is placed in the dish in a position where it will not interfere with any letters of the title. A sheet of clean glass is placed over the dish, and the title is supported on this, leaving a 1/2"-1" strip of the dish open on a side out of view of the camera. The camera, in vertical position, is set for focus and lighting (usually one light is adequate). The camera is started and a water-soluble dye is added to the dish so that the color swirls down below the title. Ordinary food colors are excellent for this purpose. Variations include adding "glitter," producing a precipitate (e.g., by using sodium chromate solution in the dish and adding silver nitrate or barium chloride solution), or producing a color change with a pH indicator solution in the dish and acid or base being added.



Scroll Titling

H. ANIMATION

Professional quality animation may be difficult to achieve in the teacher-produced film, but many valuable animation sequences have been made with simple and inexpensive equipment.* The following are examples of techniques which have been used successfully in teacher or student-produced films in chemistry.

1. Two-Dimensional Magnetic Models

Lightweight molecular models (commercial or made from flattened styrofoam balls) or their component parts, are glued to small pieces of magnetic strips (e.g., from Leyman Corp., 5178 Crookshank Road, Cincinnati, Ohio, or from Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, N.J., 08007), using duplicates of each model. A piece of posterboard of proper color is clamped in a vertical position and one set of models is placed on one side of the posterboard with the counterpart set on the other side, arranged so that each set holds its counterpart

*For further suggestions and descriptions of more advanced techniques, see "Basic Titling and Animation," Eastman Kodak Publication S-21 ($1.00).

in place by magnetic attraction. Proper camera and lighting is arranged. When filming is begun, an "animator" (or group of animators for complex motions) moves the models appropriately on the back of the posterboard, causing the front set to move in the same manner while being filmed.

"Magnetic Animation"

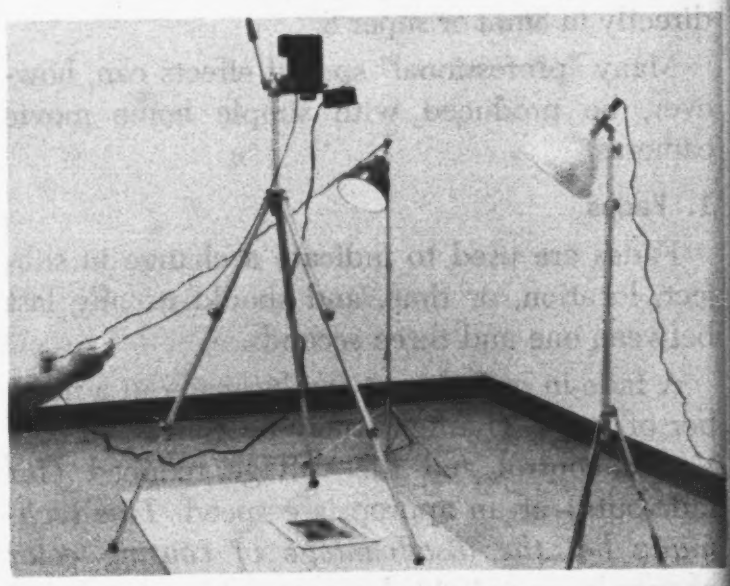
2. Three-Dimensional Model Animation

The camera is clamped in a vertical position at a proper distance from a piece of horizontal background material and is fitted with a remote cable release. Commercial or locally made models are placed on the background and are moved small distances. The models can be moved in a two-dimensional fashion and can also be rotated, or internal parts can be rotated with respect to each other, in the third dimension. For each small motion, two frames are shot. If motions are restricted to less than 1/16 inch, smooth animation can be attained. It must be remembered that 18 frames, that is 9 motions, will only use one second of projection time, so total motion should be well planned and will require a lengthy filming time. Parts of models can be replaced (functional group replacement) while the camera is "off" if the total model is held firmly so that a smooth transition appears in the film, or a similar model, such as a "mirror image" with new functional group (e.g., for a Walden inversion), can be substituted if its configuration and arrangement are made similar to that of the one being replaced. Even "smoother" animation can be done by using smaller motions and shooting one frame at a time, but the two-frame sequence is usually an adequate compromise with the time element required. It is useful to have three people involved – one to "run" the camera, one to move the models, and a third to observe, watching that motions are consistent in direction and that the hands are out of the way before the shutter is clicked.

Modeling clay or similar material can be used to simulate atomic or molecular orbitals and can be molded with small changes or "overlapped" a little at a time for single frame animation.

3. Two-Dimensional Transparency Animation

Each movable part of a total picture is drawn or copied onto a separate sheet of clear acetate. The acetate sheets are properly superimposed and the various segments are moved small distances with respect to each other, one or two frames being shot for each motion.



Transparency Animation

4. Speed Variation

To impart the idea that various parts of a scene are moving at different speeds, it is necessary only to move the parts by different distances for each exposed frame. For example, in a scene showing three models of water molecules in motion, the first might be moved about 1/32" and rotated about 10° for each frame; the second might be moved about 1/16" and rotated about 5° each time; and the third might be moved about 1/4" and rotated about 20°.

When projected at 18 fps, the film would then show one "molecule" undergoing slow translation and medium speed rotation, a second in medium speed translation and slow rotation, and a third zooming and spinning rapidly across the screen. For variable speed animation it is best to expose only one frame per motion, since the two-frame procedure will reveal a jerkiness in the faster moving objects.

I. SPECIAL EFFECTS

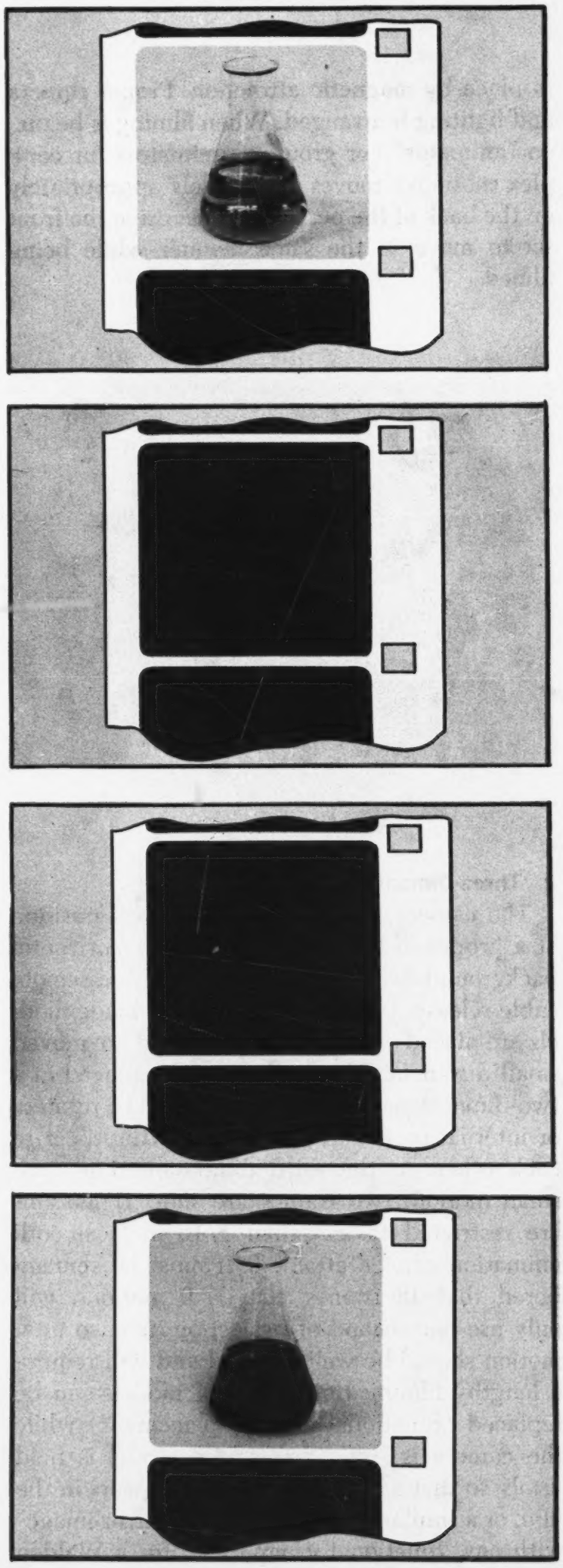
Many of the special film effects commonly seen in 16mm or larger motion pictures are produced by what is called an A, B roll printing process in which the final print is made from two different films, copying from one or the other in succession or from both simultaneously. Such familiar sequences as the fading of one scene into another or the appearance of a cartoon character in apparent conversation with live actors are examples of this process. At present, this process is not practical for film shot directly in 8mm or super 8.

Many "professional" special effects can, however, be produced with simple home movie cameras.

1. Fades

Fades are used to indicate a change in subject, location, or time, and should usually last between one and three seconds.

A fade-in or fade-out can be made in a number of ways. The lights may be connected to a Variac control and the voltage reduced (for fade-outs) at an appropriate speed. *This technique has the disadvantage of causing color change* because lights become redder at reduced voltage. Although less "professional" in appearance, a similar effect can be obtained by having assistants slowly move pieces of cardboard in front of the lights for fade-outs or slowly uncover the lights for fade-ins. A second method is to mount an iris diaphragm in front of the camera lens and slowly close the opening for fade-out or slowly open it for fade-in. Still a third procedure uses two polarizing filters in front of the camera lens so that one can be rotated until its polarization axis is at right angles to the other. All of these procedures are some-



Portions from a "fade-out," "fade-in" sequence

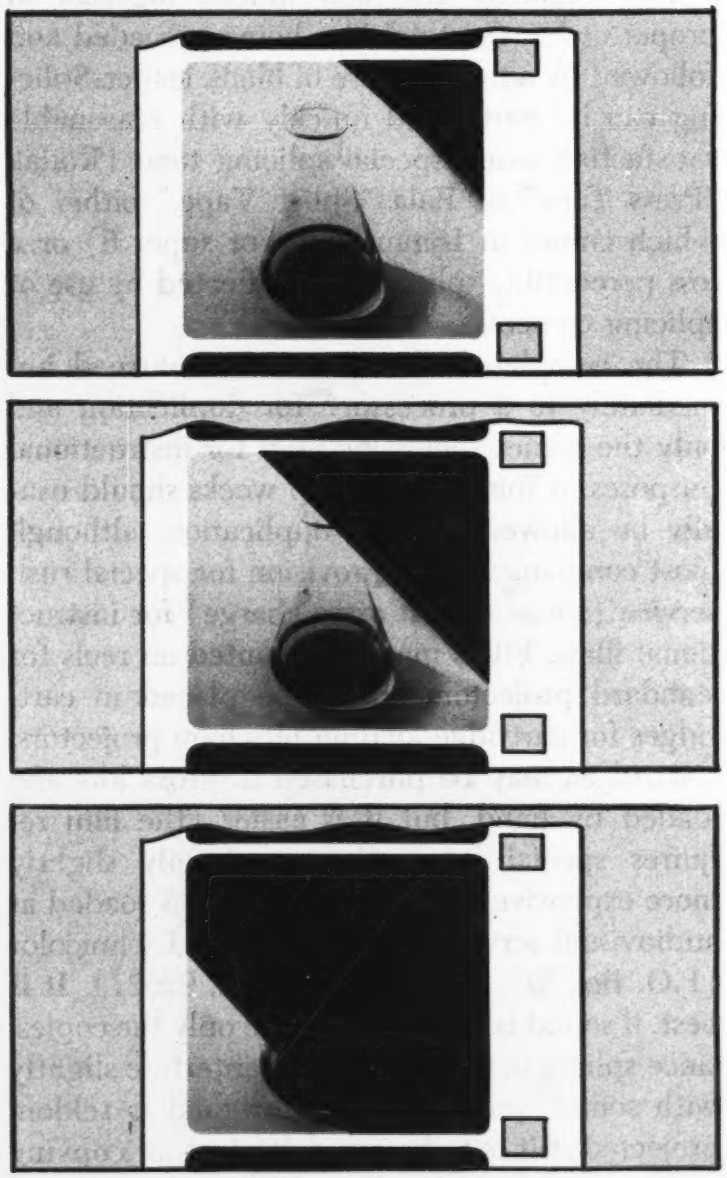
what less effective with automatic exposure cameras*.

2. Dissolves

For cameras with rewindable reels, a dissolve (superimposed fade-in and fade-out) can be effected by rewinding the film through about half of the fade-out sequence and then shooting the fade-in sequence. Accurate timing or footage counting is essential or both scenes will be ruined. Generally, a rapid transition from a fade-out to a fade-in is a satisfactory, and less difficult, substitute for a dissolve.

3. Wipes

A wipe, like a fade, can be used to indicate change in subject, time, or location. In a wipe one scene disappears a part at a time and a new scene appears in the same way.



Portions from a "wipe" sequence

The simplest technique for this effect is to slowly move an opaque card directly across the camera lens from top to bottom, side to side, or at some angle until the lens is completely covered, at which point the camera is stopped. The new scene is set, the camera is started, and the card is moved in its initial direction on across the lens until the lens is completely clear.

4. Split Screen Effects

With rewindable cameras it is possible to mask out one portion of the film, rewind the film to the appropriate place, and then shoot another sequence, using only the part of the film unexposed for the original shots. Such splitting effects are best done using a matte box (as described in Technical Information Bulletin No. 38-5 from Paillard, Inc., 1900 Lower Road, Linden, N.J.) and then only if a correct lens is used since the "mask" must be close enough to the focal point of the lens to give a sharp line.

Such effects are more difficult to produce with a cartridge-loading camera, but may be approximated by using a "screen-splitter" and filming two sequences simultaneously. This device is a half-surfaced mirror (available from Evaporated Metals, Inc., Ithaca, N.Y.) which is placed at an appropriate angle in front of the camera so that the camera viewfinder shows one scene through the mirror and the other scene reflected in it. The reflected scene will, of course, be a mirror image and must be planned accordingly (e.g., any lettering must be placed backwards). Each separate set is arranged so that the two superimposed scenes match properly without any distracting overlap. In some cases a part of each scene must be a non-reflecting black background to allow the other scene to show properly. Considerable experimentation is required for successful use of split-screen techniques.

J. PROCESSING AND EDITING

Many companies are set up to develop film, make duplicate prints and add magnetic sound stripes. Some typical sources used by the authors are:*

*Some slightly more expensive cameras, such as the Bauer C-2a or the Canon 814, have built-in fading arrangements.

*See also Appendix E.

Kodak Processing Laboratory
Kodak Park, 365 Ridge Road West
Rochester, N.Y. 14650

Hollywood Valley Film
Laboratories
2704 W. Olive Ave.
Burbank, Calif.

Calvin Productions, Inc.
1105 Truman Road
Kansas City, Mo. 64106

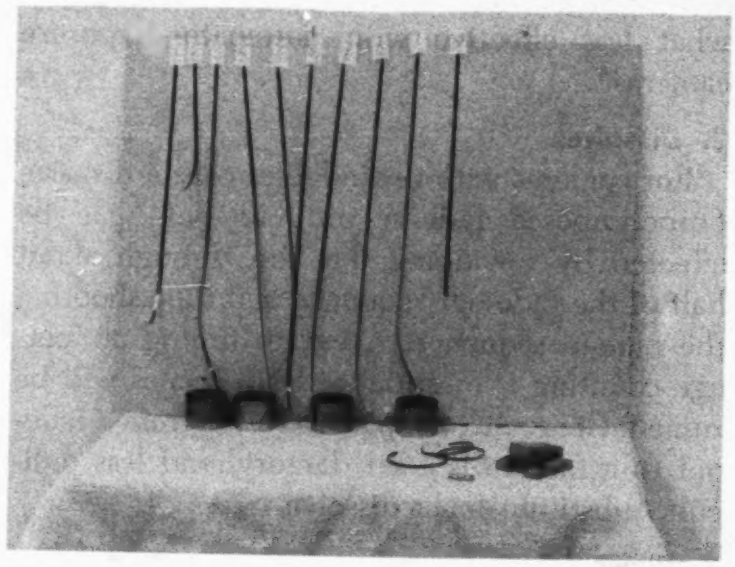
Technicolor Corp.
1985 Placentia Ave.
Costa Mesa, Calif. 92629

Once a serious beginning is made on the production of several instructional films it is wise to purchase an adequate supply of film to avoid variations in color quality, provided proper film storage conditions are maintained. It is also wise to send all the film for a given series to the same processor to maintain a continuity of color balance.

Editing of film is a tedious, but important job. Rough editing, i.e., selection of major film segments and arrangement in proper sequence, can be done with a projector, but care must be exercised in cutting the film at the proper place, since the picture seen will be a few frames out of sequence from the available cutting space. For fine editing a good commercial editor-viewer is most valuable. Such machines are arranged to advance the film rapidly or one frame at a time and usually have a device for notching or marking the film at desired cutting spots.

Cut segments of film should be hung in a dust-free area in the order in which they are to appear in the final motion picture. The 3′ x 4′ fibreboard suggested for a storyboard can be used as an editing board if it is placed upright along the back of a table and covered, along with the table, with a clean cotton sheet. One end of each film segment is attached near the top of the fibreboard, using a map pin inserted through a sprocket hole of the film. A small card identifying the film piece and its sequence number can be attached with the same pin. If the segment is longer than 3 feet, the lower portion is curled into a clean beaker.

It is important that clean white cotton gloves are worn while handling film to avoid fingerprints.

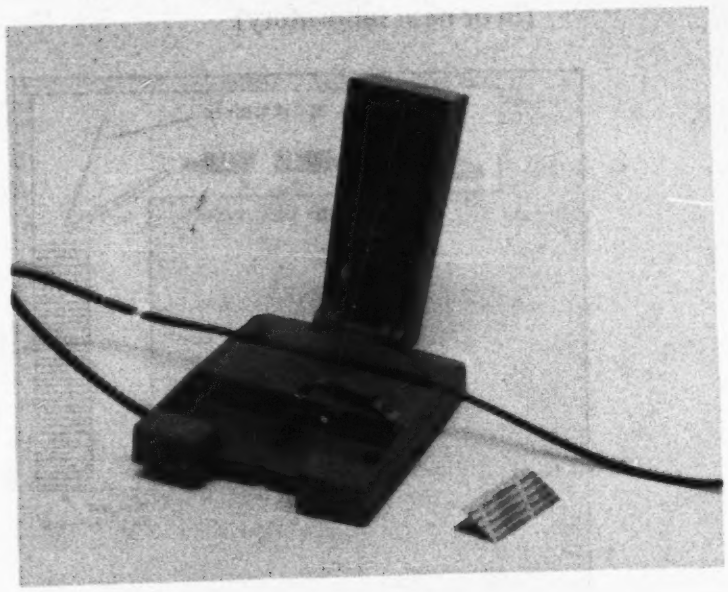


Editing Board

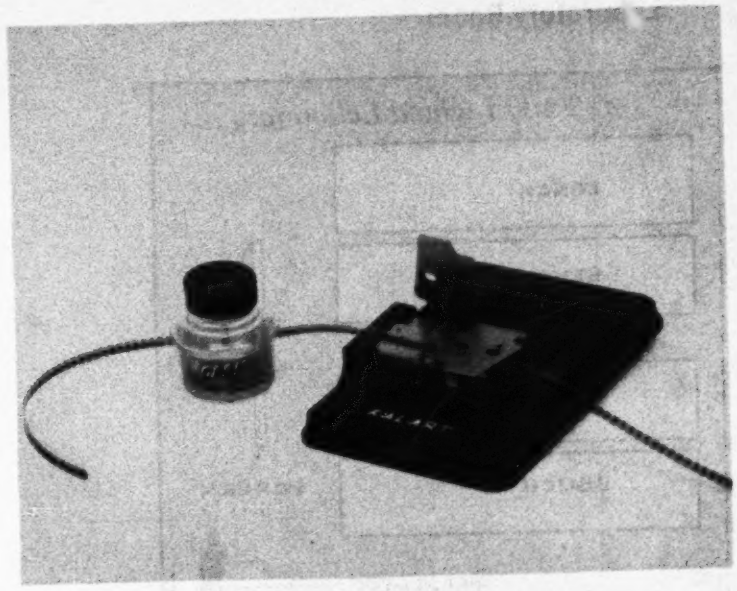
The segments are then spliced together in proper order, the total film being preceded and followed by a foot or more of blank leader. Splicing can be performed quickly with reasonable satisfaction using special splicing tape (Kodak "Press Tape" or Baia "Splice Tape," either of which comes in 16mm, 8mm, or super 8) or a less perceptible splice can be affected by use of splicing cement.

The completed film should be returned immediately to a processor* for duplication and only the copies should be used for instructional purposes. A minimum of two weeks should usually be allowed for film duplication, although most companies make provision for special rush service (sometimes at extra charge) for instructional films. Films may be mounted on reels for standard projectors or can be placed in cartridges for cartridge-loading film loop projectors. Cartridges may be purchased in gross lots and loaded by hand, but it is easier (the film requires special lubrication) and only slightly more expensive to have the cartridges loaded at audiovisual service companies or at Technicolor (P.O. Box 517, Costa Mesa, Calif. 92627). It is best, if sound is desired, to stripe only the copies, since splices in the original film interfere slightly with sound quality and the original is seldom projected if it is to be saved for further copying and/or modification.

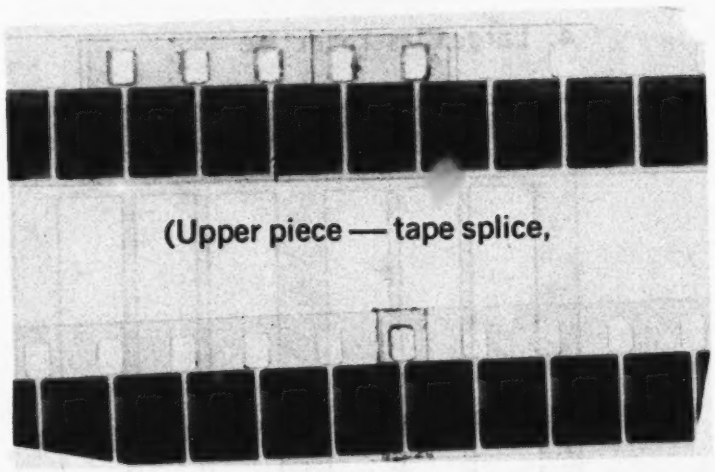
*All camera stores and most drugstores can send film for processing. Major processing companies will send addresses of local representatives capable of arranging special services on request.



Tape Splicer



Cement Splicer



(Upper piece — tape splice,

lower piece — cement splice)

Spliced Film

K. SOUND

Narration can usually add a great deal to any film, although many short silent films are adequate for special purposes.

The narration to accompany a film may be "live," with the inherent advantages of spontaneity and "narrator participation." If reasons such as multiple showings, individual student use, etc. dictate, however, sound can be included with the film.

Sound-with-film can be done in three ways. The narration can be recorded on an audio tape recorder for playback with the film, although no "foolproof" system for routine student use is available at a low price, or a permanent narration can be added to the film with an optical sound system for use with optical sound projectors or the new Technicolor sound cartridges. The latter procedure cannot be done locally, but a sound track can be recorded on an audio tape during viewing of the film and sent to a processor, such as Technicolor or Calvin Productions, for conversion to the optical sound system. Sound-picture synchronization is difficult and no attempt should be made to produce "lip synchronization" of sound with the pictures of a person talking on this basis.

A third alternative uses film to which has been added a magnetic sound stripe. Such film has the advantages of an audio tape recorder in that the sound can be added locally and erased and rerecorded at will. Such projectors as the Eastman M-100 or Eumig Mark S are designed for this purpose. Magnetic sound films can be projected in inexpensive, "automatic" student-use projectors (such as the Eastman Kodak Ektagraphic Sound 8), designed for playback only.

L. PLAYBACK AND USES

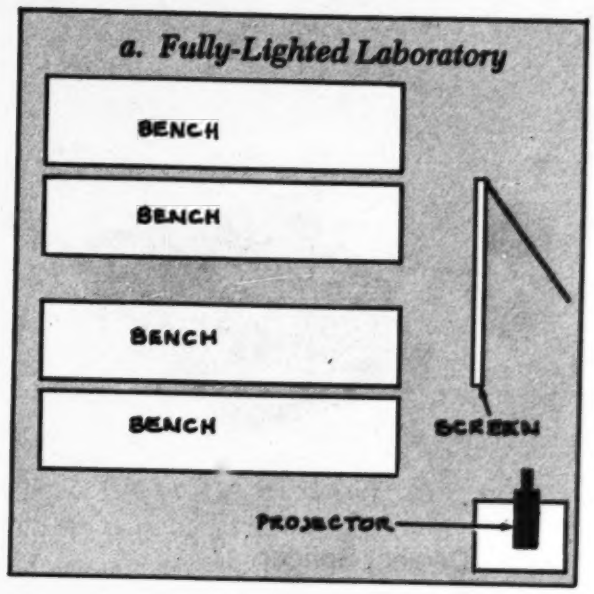
A number of examples of uses of instructional 8mm films have been discussed in Section I, A-F and examples of projection equipment are listed in Section II, C.

Since use of the films will probably be for prelaboratory instruction, individual technique review, classroom teaching aids, or individual student study of concepts or problems, some suggested designs for film use areas are included in the following drawings*.

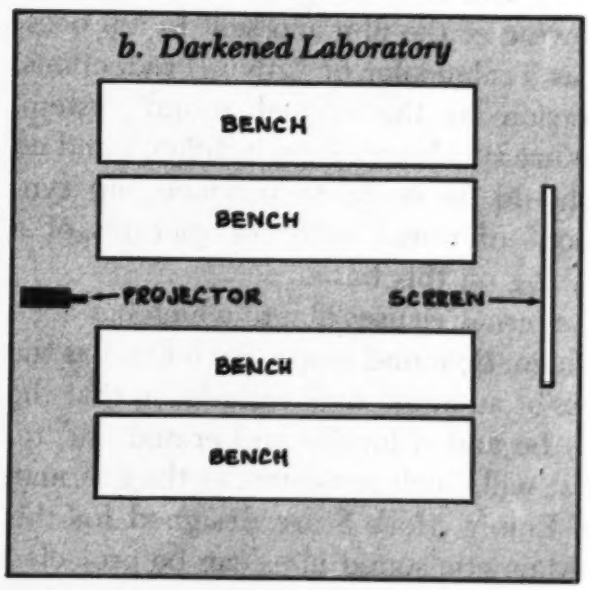
*For suggestions on suitable screens for various projection situations, see "Audiovisual Projection," Eastman Kodak Pamphlet No. S-3.

1. **Pre-Laboratory Instruction in the Laboratory Room**

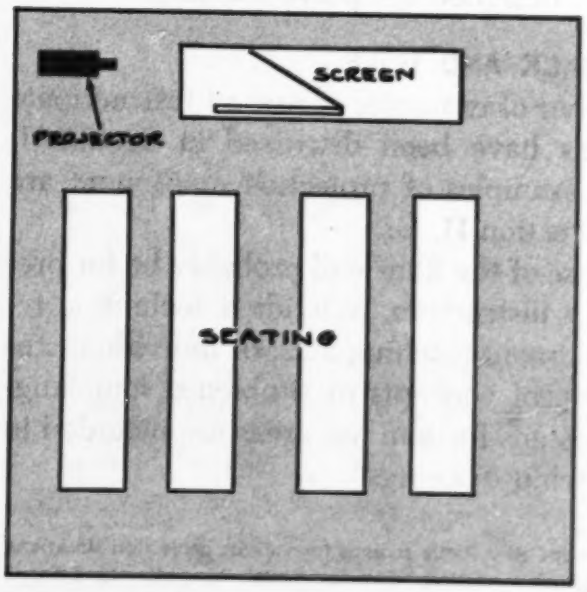
a. Fully-Lighted Laboratory



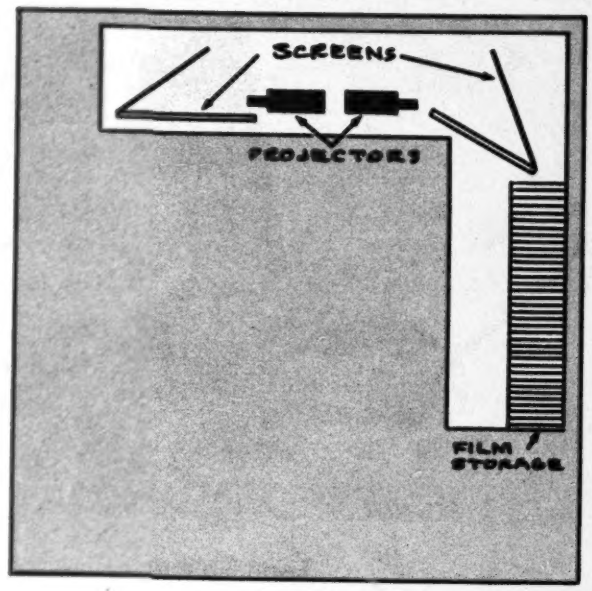
b. Darkened Laboratory



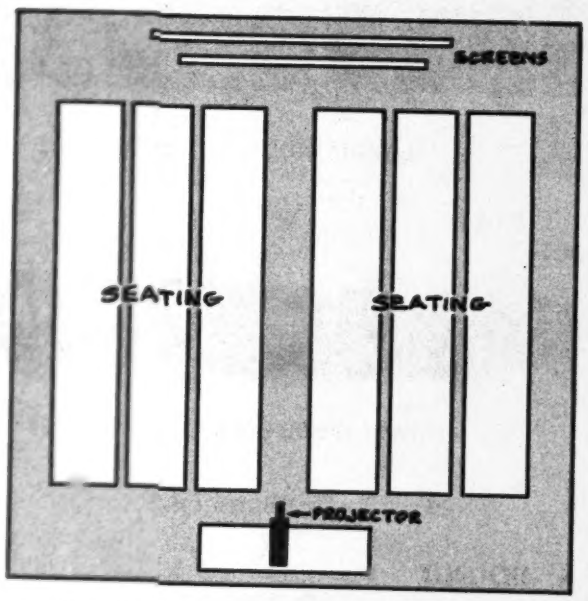
2. **Pre-Laboratory or Classroom Instruction in a Small (50 student maximum) Room.**



3. **Individual Technique Review Area (in or near laboratory)**

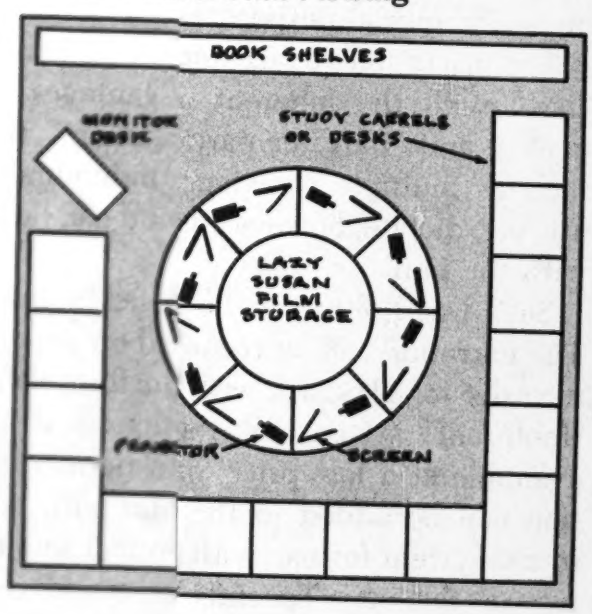


4. **Large Classroom Use**

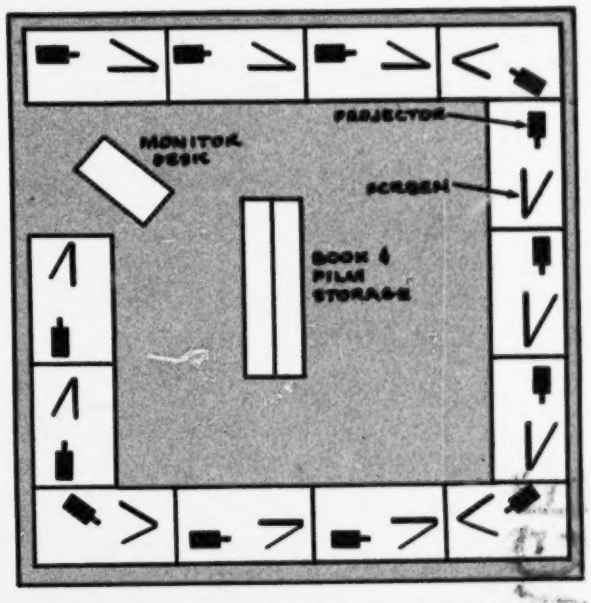


5. **Student Auto-Tutorial Room**

a. Central Film Viewing



b. Peripheral Film Viewing



M. SOME WORDS OF CAUTION

Making films for the first time can produce some frustrations which may lead, in the words of Art Campbell, to a high "activation energy" for further film production. The first films produced should be expected to fall in the category of first drafts of textbooks or first sets of lecture outlines for a new course – they won't be as satisfying or as polished as further experience can make them. Fortunately, the sheer "fun" of producing a creative effort in a new teaching medium can be a fairly effective "catalyst" in lowering this "activation energy."

It is certainly advisable to limit initial attempts to reasonably modest productions, such as familiar laboratory technique instruction or simple model animation. Adequate time should be allowed for viewing these first efforts and modifying production accordingly before more films are made and more complex effects are attempted.

For a successful film supplement to a teaching aids program, it is important that commercial films be used when they serve the educational purposes adequately, so that local film production time is not squandered on remaking motion pictures already available. Then teacher-produced films can add the material best suited for the local teaching situation in the way most preferred by those doing the teaching.

DO NOT REMOVE FROM ROOM

APPENDIX A
SOURCES OF COMMERCIAL 8mm AND SUPER 8 FILMS IN CHEMISTRY*

1. Advisory Council on College Chemistry
   701 Welch Rd.
   Palo Alto, Cal. 94304
   (films on free loan basis only)
2. Anargyros Film Library
   1813 Fairburn Ave.
   Los Angeles, Cal. 90025
3. Association Instructional Materials
   600 Madison Ave.
   New York, N.Y. 10022
4. Communication Films
   870 Monterey Pass Rd.
   Monterey Park, Cal. 97154
5. Coronet Films
   65 E. So. Water St.
   Chicago, Ill. 60601
6. Ealing Corp.
   2225 Massachusetts Ave.
   Cambridge, Mass. 02140
7. Education Development Ctr., Inc.
   55 Chapel St.
   Newton, Mass. 02158
8. Educational Found. for Visual Aids
   33 Queen Anne St.
   London, W. 1, England
9. Encylopaedia Britannica Educ. Corp.
   425 N. Michigan Ave.
   Chicago, Ill. 60611
10. Film Associates
    11559 Santa Monica Blvd.
    Los Angeles, Cal. 90025
11. Jam Handy Organization
    2821 E. Grand Blvd.
    Detroit, Mich. 48211
12. L. B. Films
    3435 Grant St.
    Corvallis, Ore. 97330
13. Macmillan and Co., Ltd.
    4 Little Essex St.
    London, W.C. 2, England
14. Modern Learning Aids
    1212 Avenue of the Americas
    New York, N.Y. 10036
15. Science Research Assoc., Inc.
    259 E. Erie St.
    Chicago, Ill. 60611
16. Systems for Education, Inc
    612 N. Michigan Ave.
    Chicago, Ill. 60611
17. Universal Educ. and Visual Arts
    221 Park Ave., So.
    New York, N.Y. 10003

*See also "Short Films for Physics Teaching" from the Commission on College Physics, Department of Physics and Astronomy, University of Maryland, 4321 Hartwick Rd., College Park, Md. 20740 and "Source Directory of Educational Single-Concept Films Available in Magi-Cartridges," 4th edition (1967) from Technicolor Corp., Commercial and Educational Division, Box 517, Costa Mesa, Calif. 92627 (25 cents).

APPENDIX B
REPRESENTATIVE EQUIPMENT SOURCES*

1. Audio-Tutorial Systems
   (Audion Projectors)
   Division of Burgess Pub. Co.
   426 S. 6th St.
   Minneapolis, Minn. 55415
   (catalog on request)
2. Brooks Cameras
   45 Kearny St.
   San Francisco, Cal. 94108
   (catalog on request)
3. Calvin Productions, Inc.
   1105 Truman Rd.
   Kansas City, Mo. 64106
   (catalog on request)
4. DuKane Corp.
   110 N. 11th Ave.
   St. Charles, Ill. 60174
   (catalog on request)
5. Eastman Kodak Co.
   Motion Picture and Educ.
   Markets Division
   Rochester, N.Y. 14650
   (catalog and address of local dealers on request)
6. Fairchild Industrial Products
   221 Fairchild Ave.
   Plainview, N.Y. 11803
   (catalog on request)

*For a more detailed listing, see "The Audio-Visual Equipment Directory" (an annual publication) from the National Audio-Visual Association, Fairfax, Va.

7. Kalart Co., Inc.
   Plainville, Conn. 06062
   (catalog on request)
8. Ohio Audio-Visual Co.
   1157 Hartford Ave.
   Akron, Ohio 44320
9. Sears, Roebuck & Co.
   925 S. Homan Ave.
   Chicago, Ill. 60607
   (catalog on request)
10. Smith-Victor Corp.
    (Lights and Light Stands)
    Griffith, Ind.
11. Technicolor Corp.
    1985 Placentia Ave.
    Costa Mesa, Cal. 92627
    (catalog and address of local dealers on request)

APPENDIX C
SAMPLE LIST OF 8mm CHEMISTRY FILMS AVAILABLE — 1967

All* of the films in this listing are available on reels at prices ranging from $10 to $20 each or in Technicolor "Magi-Cartridges" for $11-$22 each, except for films marked (F) which are more expensive and are packaged in the larger Fairchild Cartridges for use in a Fairchild projector. All except the (F) films and the AC$_3$ films are silent and of fo minutes or less duration and all are in color unle indicated as (bw). Many 8mm films will be ava able in super 8 versions by 1968. For information available formats, specific prices, and preview a rangements, contact the distributor listed.

1. Laboratory Technique Films

General Technique	Film Title	Source No. from Appendix A	Source Catalog Number
Weighing	Weighing Procedure	9	R80451
	Weighing: Triple-Beam Balance	9	R80452
	The Triple Beam Balance (super 8 only)	1	———
	Weighing with Triple-Beam Balance	6	84-006
	Setting Up the Balance	2	PM/461
	Using the Balance	2	PM/462
	Weighing With Two-Pan Balance	6	84-005
	The Analytical Balance (super 8 only)	1	———
	Anal. Balance: Tare Wt. Determination	9	R80453
	Anal. Balance: Weighing Sample and Container	9	R80454
	The Single-Pan Balance	1	———
	The Mettler Balance	12	No. 8
	The Sartorius Balance 2400	12	No.9
Volumetric Glassware and Titration	Density	9	———
	Volume (F)	9	———(F)
	Use of Pipette	6	84-009
	Use of Volumetric Glassware (super 8 only)	1	———
	Use of Burette	6	84-008
	Using a Burette	8	R80456
	Titrating with Phenolphthalein	8	R80458
	Titration	12	No. 1
	Titration	1	———
	Titration Curves	12	No. 7
	Automatic Titrations	1	———

*AC$_3$ films are presently available only on a free loan basis.

APPENDIX C (Continued)

General Technique	Film Title	Source No. from Appendix A	Source Catalog Number
Precipitation and Related Techniques	Filtration	6	84-007
	Filtering	9	R80455
	Decanting and Washing a Residue	9	R80457
	Precipitation, Filtration and Ignition (super 8 only)	1	———
Miscellaneous Techniques	Handling Solids and Liquids	6	84-001
	The Bunsen Burner	6	84-002
	Heating Solids	6	84-003
	Heating Liquids	6	84-004
	Working Glass	6	84-010
	Solution, Evaporation and Crystallization	3	———
	Determination of V.P. by Barometer	7	SP/H/7
	Acid-Base Indicators	1	———
	Paper Chromatography	4	CP/435
	Paper Electrophoresis	4	CP/435
	Thin-Layer Chromatography	4	CP/435
	Slide Rule (series)	6	83-001 to 83-008

2. Films for Lecture Aids and/or Individual Study

Topic	Film Title	Source No. from Appendix A	Source Catalog Number
Atomic Theory and Atomic Structure	Rutherford Scattering (computer-animated)	9	———
	Rutherford-Royd's Identification of Alpha Particles in Helium	9	R80208
	Aston's Mass Spectrograph	9	R80209
	Thompson's Positive Ray Parabolas	9	———
	Electric Interactions in Chemistry (F)	14	(F)
	Atomic and Bonding Orbitals	12	No. 6
	Hydrogen Atom as Viewed by Quantum Mechanics (F)	14	(F)
Nuclear Change	Transuranium Elements (F)	14	(F)
	Nuclear Reactions (series)	4	59600-1 thru 59600-5
	Half-Life of a Radioactive Coin (bw)	9	———
	Radioactive Decay	6	———
	Scintillation Spectrometry	6	———
	Critical Size	9	R80207
	Chain Reaction	9	R80206
	Atmospheric Distribution of Nuclear Fallout	4	———
	Biological Effects of Nuclear Radiation	4	———
	Detonation of the H-Bomb (bw)	2	S-4
Chemical Changes	Alkali Metal Reactions	1	———
	Chemical Bonding (F)	14	(F)
	A Slow Reaction and A Very Fast Reaction	3	———
	Conditions Necessary for Combustion	4	1315
	The Mercury Beating Heart	12	No. 12
	Corrosion (series)	12	No. 13, 14, 15
	Shapes and Polarities of Molecules (F)	14	(F)
	A Research Problem — Inert Gas Compounds (F)	14	(F)
	Building Atom Models — Isomerism (bw)	3	———
	Acid-Base Reaction in Electrolysis of Water	3	———

APPENDIX C (Continued)

Topic	Film Title	Source No. from Appendix A	Source Catalog Number
Solids, Liquids, and Gases and Change of State	Most Solids Melt	4	1301
	Bubble Model of a Crystal (2 films)	6	84-011 and 84-012
	Stretching (of metals)	11	2290-1
	A Problem in Diffraction (bw)	1	———
	Crystal Structure of Metals	1	———
	Crystal Structure of Metals	12	No. 2
	The Ice Cubes	15	8-9366
	Liquid Crystals	1	———
	Liquids Evaporate	4	1302
	Determination of Vapor Pressure by Barometer	10	SP/H/7
	Vapor Pressure and Temperature	10	SP/H/8
	Vapor Pressure and Boiling	10	SP/H/9
	Boiling Points of Water	4	1309
	Boiling by Cooling	15	3-9352
	Heat Expands Gases	4	1305
	Gas Pressure	1	———
	Absolute Zero	1	———
	Temperature and the Boltzman Distribution	1	———
	Critical Temperature of SO_2	10	SP/H/6
	Critical Temperature	6	———
	A Model of Kinetic-Molecular Concept	12	No. 16
	The Meaning of Pressure	8	———
	Computer Motion — Ten Balls	1	———
	Maxwell Speed Distribution	6	———
	Maxwell — Boltzman Distribution of Velocities	9	———
	Pressure 2 — Simple Kinetic Theory	13	———
	Gas Pressure and Molecular Collisions (F)	14	(F)
	Properties of Gas	6	———
	Equipartition of Energy	6	———
	Diffusion	6	———
	Phase Change	9	R80601
	Phase Demonstration	3	———
	Phase Diagram for Bi/Cd Alloy	12	No. 3
Thermodynamics, Kinetics, and Equilibrium	Mechanical Equivalent of Heat	10	———
	Equilibrium (F)	14	(F)
	LeChatelier's Principle	3	———
	Introduction to Reaction Kinetics (F)	14	(F)
	Kinetics of Following Dispersions	12	No. 10
Electro-chemistry	Voltaic Cells	4	1008
	Lead-Acid Storage Battery	4	1010
	Copper-Silver Cell	1	———
	Hydrogen-Silver Cell	1	———
	The Primary Cell	10	———
	Electrodes and Cell Processes (F)	14	(F)
	Electric Interactions in Chemistry (F)	14	(F)
	Photo-Electricity	13	SP/E/5
	Photo-Electric Cell	13	SP/E/6
Spectroscopy and Photochemistry	Light and Color: The Spectrum	4	1222
	Heat Distribution in the Spectrum	10	SP/H/1
	Emission and Absorption of Radiation	10	SP/H/2

APPENDIX C (Continued)

Topic	Film Title	Source No. from Appendix A	Source Catalog Number
	Infrared Spectroscopy	1	———
	Molecular Vibrations	1	———
	Molecular Spectroscopy	1	———
	Particles	9	———
	A Wave Equation	4	———
	Absorption Spectra	6	———
	Molecular Spectroscopy (F)	14	(F)
	Spectrum of the Hydrogen Atom	9	———
	Vibration of Molecules (F)	14	(F)
Miscellaneous Topics	Ion Exchange	1	———
	Polymer Science (3 films)	1	———
	Minerals and Ores	12	No. 5
	Flocculation of Sols	12	No. 11
	Photosynthetic Fixation of CO_2 (2 parts)	14	6106, 6107
	Structure of a Covalent Molecule	9	———

APPENDIX D
Sample Checklist for Making a Film

1. Contents
   - General Planning _____
   - Storyboard _____
   - Script _____
   - Titles Prepared _____
   - Dress Rehearsal _____
   - Production Time Scheduled (Staff) _____
2. Hardware
   - Camera, equipment* and lights tested and on hand (*Includes tripod, tape measure, lightmeter, other _____) _____
   - Extra batteries, light bulbs, film and extension cords _____
   - Electrical outlets adequate _____
   - Scene equipment on hand (Beakers, burets, models, etc.) _____
   - Set arranged _____
   - Special Effect Equipment _____
   - Titles and Titling Equipment _____
3. Procedure (each scene)
   - Rehearsal with camera lens viewing (lens cap removed) _____
   - Lens-to-subject distance measured _____
   - Camera Focus Set _____
   - Lighting Checked _____
   - Camera Exposure Set _____
   - Special Effects Crew Ready _____
   - Film Scene _____

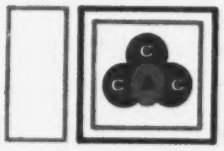
— Repeat for each scene —

APPENDIX E
REPRESENTATIVE PROCESSING LABORATORIES*
(Some of the laboratories in this listing do not process all types of film).

EAST COAST

1. Atlanta Cine Labs Co.
   331 Luckie St.
   Atlanta, Ga. 30313
2. Byron Motion Pictures, Inc.
   1226 Wisconsin Ave., N.W.
   Washington, D.C. 20024
3. Capital Film Labs., Inc.
   470 E. St., S.W.
   Washington, D.C. 20024
4. Cine Service Labs., Inc.
   51 Kondazian St.
   Watertown, Mass. 02172

*For local Eastman Kodak dealers and inquiries on processing services, write: Eastman Kodak Company, Color Print and Processing Services, Building 65, Kodak Park, Rochester, N.Y. 14650; Telephone (716) 458-1000.



APPENDIX E (Continued)

5. Cinema Processors, Inc.
   2156 Faulkner Road, N.E.
   Atlanta, Ga. 30324
6. Cinemat, Inc.
   324 Franklin Sq.
   Buffalo, N.Y. 14202
7. Commercial & Home Movie Ser.
   614 Washington St.
   Allentown, Pa. 18104
8. Freese Camera Shop, Inc.
   306 George St.
   New Brunswick, N.J. 08901
9. Instructo-Graphic Films, Inc.
   3184 Roswell Rd., N.E.
   Atlanta, Ga. 30305
10. Irving Magilnick Photo
    Flint Ridge Rd.
    Monroe, Conn. 06468
11. Mastercraft Telefilms
    41 E. Market St.
    Wilkes Barre, Pa. 18701
12. Perdue Motion Pictures
    2315 Williamson
    Roanoke, Va. 24012
13. Pittsburgh Motion Picture Lab
    116 Seventh St.
    Pittsburgh, Pa. 15222
14. Russell Film Labs., Inc.
    4805 Lenox Ave.
    Jacksonville, Fla. 32205
15. S. Spencer Moore Co.
    118 Capitol St.
    Charleston, W.V. 25301
16. Syracuse Movie Lab.
    537 Butternut St.
    Syracuse, N.Y. 13208
17. United Sports Labs
    15 No. Market St.
    Selinsgrove, Pa. 17807
18. U.S. Photo Equipment Co.
    40-13 - 104th St.
    Corona, N.Y.

MIDWEST

1. Brittons Photo Supply Co.
   Depot Rd/Austin Ave.
   McAllen, Tex. 78501
2. Calvin Productions, Inc.
   1105 Truman Rd.
   Kansas City, Mo. 64106
3. The Camera Shop, Inc.
   60 E. Broadway
   Muskegon Heights, Mich. 49444
4. Capital Film Service, Inc.
   1001 Terminal Rd.
   Lansing, Mich. 48906
5. Cine Graphic Film Lab., Inc.
   101 N. 17th St.
   St. Louis, Mo. 63103
6. Cinema Processors, Inc.
   211 E. Grant Ave.
   Chicago, Ill. 60611
7. Cornhusker Film Processing Lab
   1817 Vinton St.
   Omaha, Nebr. 68108
8. ESO-S Pictures, Inc.
   1121 W. 47th St.
   Kansas City, Mo. 64112
9. Filmlab Service, Inc.
   2502 Payne Ave.
   Cleveland, Ohio 44114
10. Frank Slattery Motion Pictures
    329 - 9th St.
    Lorain, Ohio 44052
11. Galaxy Film Service, Inc.
    1511 Hennepin
    Minneapolis, Minn. 55403
12. George W. Colburn Lab., Inc.
    164 N. Wacker Dr.
    Chicago, Ill. 60606
13. Gerdes Photography
    204 E. Constitution
    Victoria, Tex. 77901
14. Grand Rapids Camera Shop
    22 N. Davidson Ave.
    Grand Rapids, Mich. 49502
15. Hamiltons
    2108 Rimrock Rd.
    Billings, Mont. 59102
16. Harolds Film Service
    41st/Prairie
    Sioux Falls, S.D. 57101
17. Hytone Film Lab, Inc.
    1702 Keosauqua Way
    Des Moines, Iowa 50314
18. Karls Camera Supply
    7th and Joplin
    Joplin, Mo. 64801
19. Redmond Cinema Service
    814 Woodbury Ave.
    Kalamazoo, Mich. 49007

20. Slaughter Film Service
    1001 E. Missouri St.
    El Paso, Tex. 79902
21. Southwest Film Service
    3547 Monroe St.
    Lake Charles, La. 70601
22. United Film Industries
    1028 Acoma St.
    Denver, Colo. 80204
23. Waltz, The Camera Man, Inc.
    438 Sixth St., N.W.
    Canton, Ohio 44702
24. Waltz, The Camera Man, Inc.
    1195 W. 5th Ave.
    Columbus, Ohio 43212
25. Wayne Agner
    Rural Route 2
    McComb, Ohio 45858
26. Western Cine Service, Inc.
    312 S. Pearl St.
    Denver, Colo. 80209

WEST COAST

1. Alpha Cine Laboratory
   1001 Lenora St.
   Seattle, Wash. 98121
2. Alpha Cine Laboratory
   E. 213 Second Ave.
   Spokane, Wash. 99202
3. Arnie's Movie Service
   2648 N. Campbell Ave.
   Tucson, Ariz. 85702
4. Bill Navarro Photograph Ser.
   2338 E. McDowell Rd.
   Phoenix, Ariz. 85008
5. Cal Photo Lab
   3494 Pickett Ave.
   San Diego, Calif. 92110
6. Campbell Film Service
   511 Warm Springs Ave.
   Boise, Idaho 83702
7. Chuck Dowell Film Labs
   1833 Van Ness Ave.
   Fresno, Calif. 93721
8. Cine Craft Corp.
   8764 Beverly Blvd.
   Los Angeles, Calif. 90048
9. Forde Motion Picture Lab
   2153 N.E. Sandy Blvd.
   Portland, Ore. 97232
10. Forde Motion Picture Lab
    306 Fairview Ave., N.
    Seattle, Wash. 98109
11. Hollywood Valley Film Labs.
    2704 W. Olive Ave.
    Burbank, Calif.
12. Leo Diner Films, Inc.
    350 Golden Gate Ave.
    San Francisco, Calif. 94102
13. Multi Color, Inc.
    2 N. 30th St.
    Phoenix, Ariz. 85034
14. Sportfilm Processing
    9048 Rives Ave.
    Downey, Calif. 90240
15. Technicolor Corp.
    1985 Placentia Ave.
    Costa Mesa, Calif. 92629
16. Torres Film Service
    534 E. Oak St.
    Stockton, Calif. 95202
17. Western Cine
    1138 N. LaBrea Ave.
    Hollywood, Calif. 90038